Skyways

Flight Operations
•
Engineering
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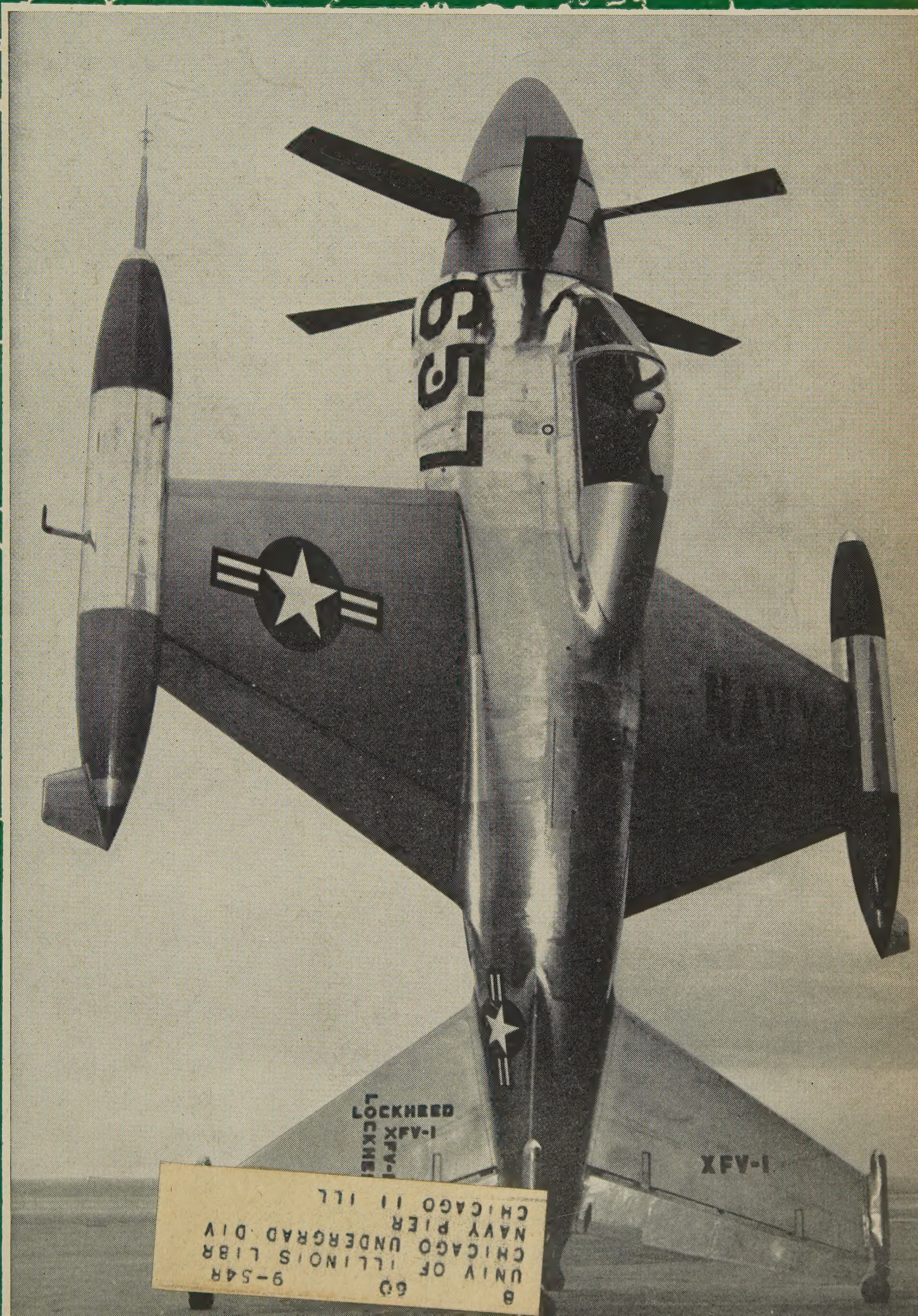
Management



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MORE LEAR AUTOPILOTS WERE PRODUCED IN 1953 THAN ALL OTHER MAKES COMBINED!

MAY, 1954

Skyways

Flight Operations • Engineering • Management

Cover: Lockheed's new TVO fighter, the XFV-1

FOUNDED BY J. FRED HENRY, 1942

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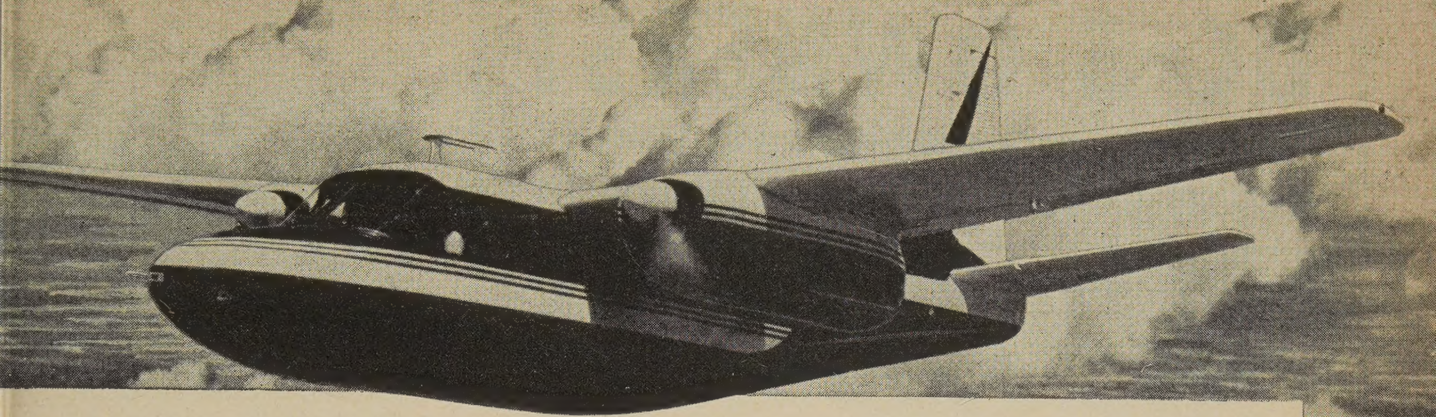


now hear this . . .

PERSONNEL

Stephen F. Keating has been appointed to the newly created post of vice president of the Aeronautical Division of Minneapolis-Honeywell Regulator Co.

Morwick Ross has joined Northrop Aircraft as executive assistant to John R. Alison, administrative vice president.

Chester D. Seftenberg was named Treasurer of Lear, Inc. Mr. Seftenberg was the former Deputy Assistant Secretary of the Air Force. He will make his headquarters in Grand Rapids.

Luke Harris has been named vice president in charge of operations, West Coast activities, of Aircraft Engine and Parts Co.

Capt. Bill Moss, Pan American World Airways, is now Assistant Chief Pilot, Training, Atlantic Division, Pan American World Airways.

Clarence Carruthers has been elected president of the Hydraulic Starter Corp., New York, N.Y.

George L. Duke has been named manager of purchases for the Aviation Gas Turbine Division of Westinghouse.

J. H. Lasley recently was appointed Technical Administrator of the Servo Corporation of America. **H. F. Penfold,** former assistant director of sales of Collins Radio, has joined Servo's staff as Sales Manager.

Edmund B. Parke has joined the Manufacturing Dept. of Fairchild Engine Div. of the Fairchild Engine and Airplane Corp.

Thomas M. Sullivan has been appointed Fairchild's West Coast Representative and is located at Fairchild's new West Coast office in Hollywood, Calif. **Major Lloyd M. N. Wenzel,** USAF, is now assigned as Air Force Plant Representative for the Fairchild Aircraft Div. at Hagerstown, Md.

Jack S. Hakes, formerly manager of Mitchell Field, Milwaukee, has joined the sales promotion staff of the Hertz Rent-A-Car System.

Leverett P. Wenk has been promoted to personnel director of Republic Aviation Corp.; **R. A. Vernon** has been upped to chief of budget and forecast division; and **George A. Cole** has been named chief of experimental planning and control of Republic.

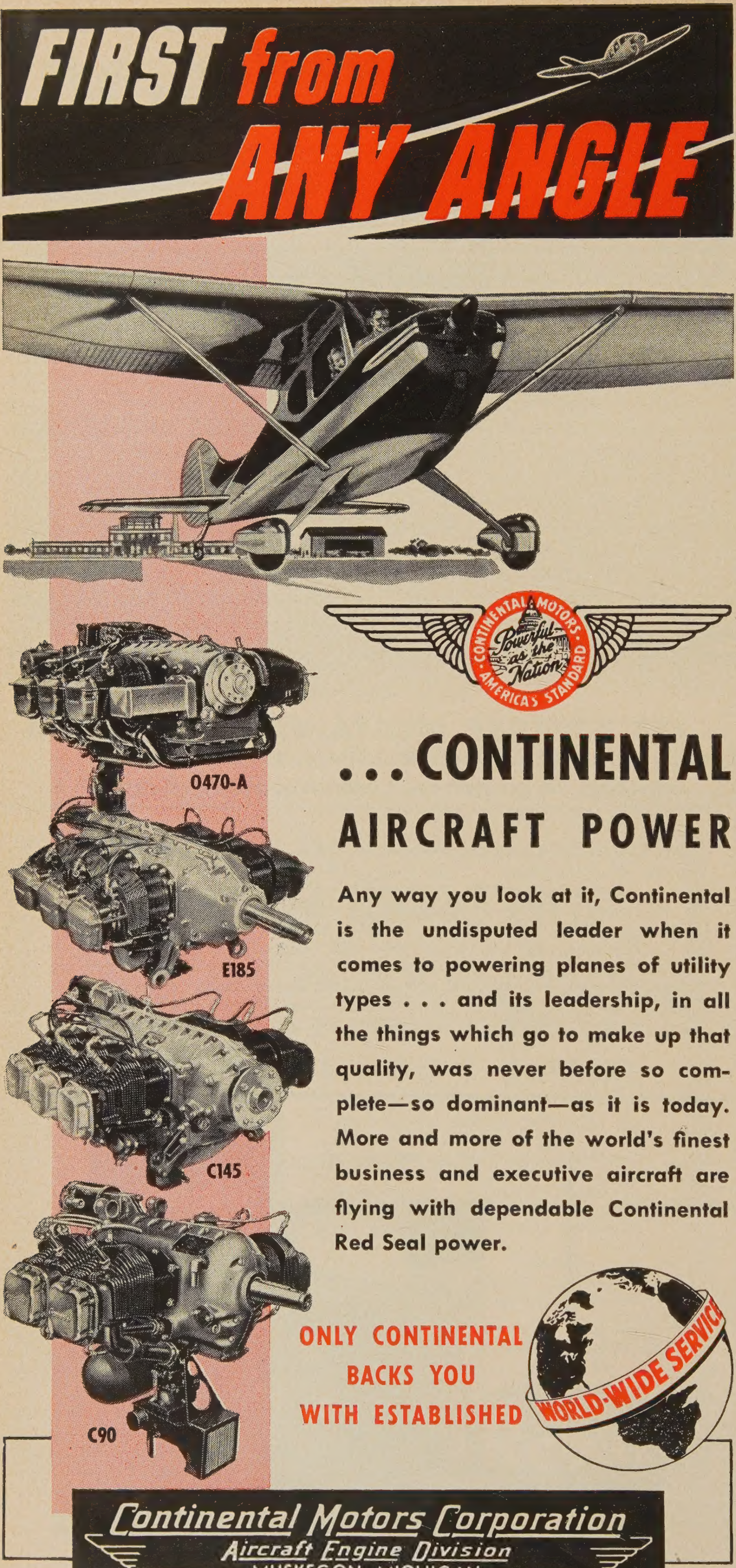
Jack M. Weidner recently was named Director of the American Aeronautical Association for the state of California. This organization formerly was known as the U.S. Flight Instructors Association.

Eugene Babcock has been promoted to operating supervisor of the Libby-Owens-Ford Glass Company's Electrapane plant at Toledo, Ohio.

Roy G. Fisher is now superintendent of the engine shop at Dallas Aero Service, Dallas, Texas.

Jeffrey Sidebotham has joined the administrative staff of Pastushin Aviation Corp. as Contract Administrator. **Joe Rosales** has joined Pastushin as works manager.

(Continued on Page 8)



now hear this . . .

COMPANIES

Magnavox Company has been elected to membership in the Radio Technical Commission for Aeronautics.

Goodyear Aircraft Corp. has received a contract from Boeing for additional canopy assemblies for the USAF B-47.

Aubrey L. Moss has announced the organization of **Avio Supply Corporation,** Brooklyn, warehouse distributors and purchasing agents for aircraft parts and supplies, engines, accessories, spares, airframes, radio and electronics.

Stratoflex, Inc. has moved to new offices at 5255 River Oaks Blvd., Fort Worth, Texas.

Link Aviation, Inc. has entered into an agreement with General Precision Equipment Corp. for the affiliation of Link with that company. Link will operate under its present management.

Trans World Airlines has announced a $146,000 modification contract with Lockheed Aircraft Corp. to enable its fleet of 20 new turbo-compound *Super Constellations* to accommodate the latest in visual radar equipment. Delivery of the *Super Connies* is expected in 1955.

AERO CALENDAR

May 4-6—Symposium on Electronic Components. Dept. of Interior Auditorium, Washington, D. C.

May 5-7—Third International Aviation Trade Show. 71st Regiment Armory, New York.

May 5-7—Northeastern District Meeting, American Institute of Electrical Engr. Van Curler Hotel, Schenectady, N. Y.

May 6-8—IAS first annual West Coast Industry-Faculty Conference and fourth annual West Coast Student Conference. Los Angeles.

May 10-12—National Conference of Airborne Electronics, fifth annual convention. Dayton Biltmore Hotel, Dayton.

May 16-19—American Association of Airport Executives, national convention. Louisville, Ky.

May 20—Women's National Aeronautic Association 1954 Skylady Derby for stock model aircraft up to 300-hp. Raton, New Mexico to Kansas City, Mo.

June 1-5—National Flying Farmer Convention. Fresno and Yosemite Nat'l Park, Calif.

June 5-12—Second Annual Transcontinental Air Cruise sponsored by Philadelphia Junior Chamber of Commerce. Take-off from N. Philadelphia Airport.

June 21-24—IAS Annual Summer meeting, IAS Bldg. Los Angeles, Calif.

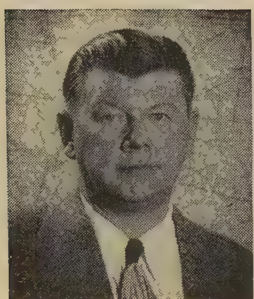
June 21-23—Mid-Year Meeting, Aviation Distributors and Manufacturers Assn. Stanley Hotel, Estes Park, Colorado.

June 24-26—The 10th Annual Forum of The American Helicopter Society. Mayflower Hotel, Washington, D. C.

July 19-23—Annual Air Force World-Wide model airplane championships. Biggs Air Force Base, El Paso, Texas.

July 27-Aug. 5—The 21st National Soaring Championship Contest. Elsinore, Calif.

MODERN EXECUTIVE AIRPLANE
as a medium of transportation



by Wm. P. Lear

Chairman of the Board, Lear, Inc.

A nationally circulated magazine recently carried an article reporting the development of a theory which may sound the deathknell of the executive airplane. This theory, allegedly accepted as completely sound by leading scientists, provides for the synthetic duplication, exact in every detail, of any human being. The proposed means to this end involves the kind of reproductive growth process employed by the starfish to replace in identical configuration a severed portion of its body, and is to be controlled by the chromosomes in a bit of living tissue from the prototype. Now, if exact duplication of human beings becomes possible, perhaps then industry will be able to order "reprints" of top executives. These duplicates could be strategically dispersed throughout an organization, allowing the executives, in effect, to be in a great many places at the same time, and eliminating the need for executive airplanes. With a large supply of executive man-power, salaries should plummet, making the project economically feasible.

In the meantime, however, lacking any way to put a man in several places at the same time, we must content ourselves with the fullest possible exploitation of the valuable time of our key personnel by moving them from one place to another as fast, as comfortably, as economically, and as safely as possible.

The application of the airplane to this job of executive transportation has brought forth a new giant in the field of civil aviation, whose stature may soon become the greatest in this field. In this country there are more executive aircraft, providing more passenger seats, and flying more hours per year than all the domestic airlines combined. The total investment represented is in excess of two hundred million dollars.

This vast operation includes many different types of equipment used to meet varying transportation needs. However, although there are certain highly specialized transportation problems, utilizing such special types of equipment as water-based aircraft and helicopters, by far the greater number of our business aircraft are land-based airplanes.

Most of these can be included in three general classifications of business transportation. In name these classifications are based on large corporation structure. However, each of the first two categories also includes smaller firms whose over-all size and/or geographical field of activity is not large enough to make the following transportation classifications applicable.

The first category in which executive airplanes are utilized may be termed Intraterritorial Transportation. As the name implies, the requirement here is for transportation of company personnel within a limited geographical territory. These persons may represent any phase of normal operations of any corporate division, but only within their limited territory. These people, generally, must go to the prospects or customers wherever they may be, and this requires airplanes capable of using the smallest airports.

Since trip lengths, limited by the

Comparison of Four Corporation Transport Design-Proposals: Payload, 2,400 lbs.—Range, 2,700 st. mi.—Cruising, W/S = 60 lb./□ft.

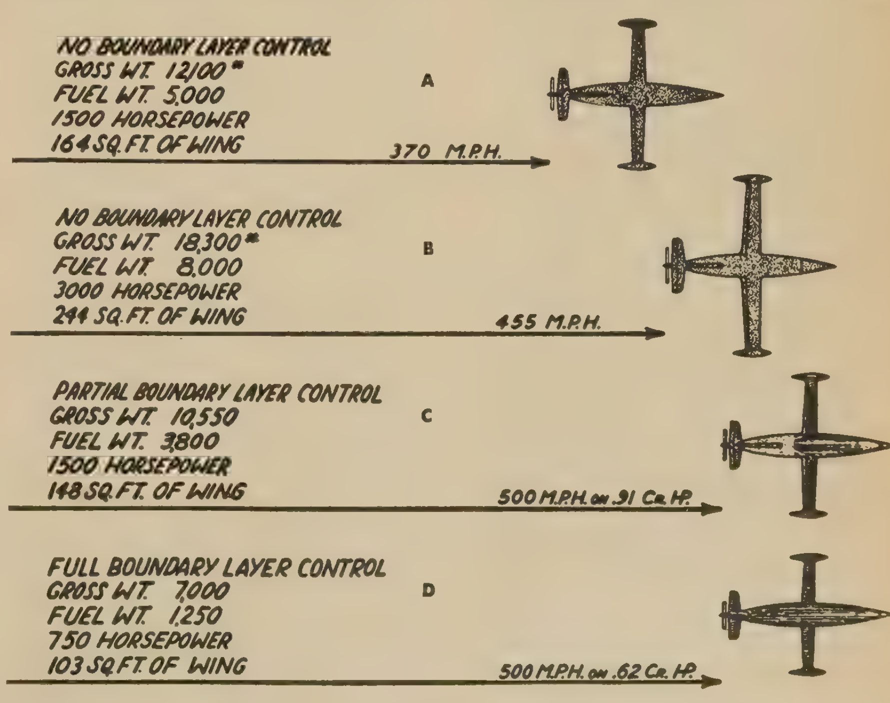
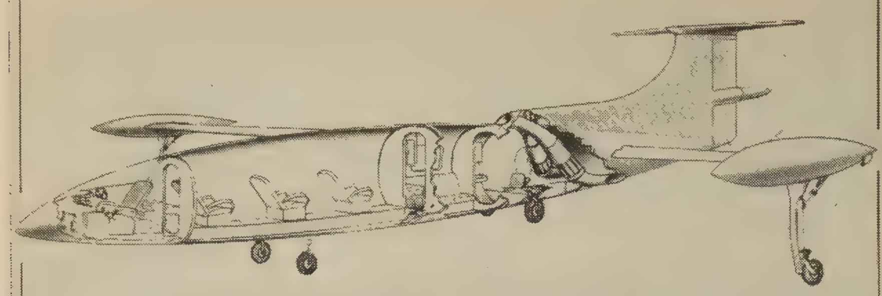


FIG. X



Projected Executive Airplane
Using Boundary Layer Control

FIG. Y

boundaries of the territory, are relatively short, high cruising speed is of little added advantage and can readily be compromised, if necessary, in favor of short-field performance. The territorial representative usually must be his own pilot, which points up the desirability of easy-to-fly airplanes, so that an undue amount of otherwise productive time need not be devoted to maintaining extreme pilot skill. The average territory call requires the presence of only the one representative, and very rarely would it be necessary or desirable for more than three or four persons to make the same trip at the same time. Therefore, airplane seating capacity can be low. In many cases single-seat equipment, offering maximum economy of operation, will suffice. Naturally, since the transportation of only one person is the usual requirement and since the issue at stake in the average individual trip is of relatively minor potential benefit, it is necessary that the cost of transportation be kept to a minimum, again indicating the small lightplanes, many of which can be operated at lower cost than automobiles.

Thus for this category of transportation we find businesses choosing equipment from the ranks of the smaller airplanes, which are available in a large number of different configurations and which are highly efficient machines. Utilized by industry for Intraterritorial Transportation are dozens of types, from the tiny, single-seat Mooney *Mite* up through the various two-to-four-place fabric-covered lightplanes to the higher performance all-metal *Navions,* Cessnas and *Bonanzas* and, occasionally, a light twin-engine airplane such as a Piper *Apache, Twin-Bonanza* or *Twin-Navion.* The average airplane in this category has a low acquisition cost and is inexpensive to operate and maintain. It is not overly fast, but will operate in and out of virtually any airport. It is easy and safe for the non-professional pilot to fly.

The fact that it is now thoroughly practical and easy for an average pilot to fly one of these small airplanes under IFR conditions is a prime factor in the current steady increase in the number of these airplanes going into company use. Even for those pilots who choose not to make instrument flights as a general practice, the knowledge that instrument weather enroute can be taken in stride, if necessary, allows them to make, often under VFR conditions all the way, many trips which would otherwise have been postponed due to a *possibility* that instrument weather might be encountered. Similarly, the instrument-rated pilot of a small airplane can make many a take-off for a 99% VFR trip, while the visual contact pilot is grounded, perhaps for days, by local cloud formations. Therefore, in addition to its other characteristics, the average airplane used for Intraterritorial Transportation is equipped for instrument flying, though IFR flights are the exception.

Corporate Division Transport

The second general classification of executive airplane usage may be called Corporate Division Transportation. The persons requiring transportation in this category are at division and department management levels. Trips are made between division administrative headquarters and division plants and also to the headquarters and plants of major customers and suppliers. Trips are usually longer than those required for Intraterritorial Transportation, and may extend across or out of the country. Thus, cruising speed is of much greater importance, and work space, comfortable furnishings, lavatory and, perhaps, galley are required. Destinations usually provide better than minimum airports, somewhat reducing the requirement for maximum short-field performance. However, off-airways airports frequently are visited and good short-field performance is still highly desirable. Handling matters of considerable import and often of broad scope, the executives at this level are likely to travel in groups, often accompanied by aides and technicians, which establishes the need for considerable seating capacity. Operational dependability must be at least equal to that of the airlines which means that instrument and radio equipment as well as pilots must be airline calibre or better.

As we come now to the point of reviewing the equipment in use by this group, we find that, differing from the travelers in our first classification, users of Corporate Division Transportation have had only a few airplane types from which to choose and there has been *no* airplane specifically designed and built to serve the average needs of this group. The closest thing to an airplane produced specifically to this group's requirements is the Twin-Beech, a 15-year-old design, but one whose designers had in mind utilization of the airplane by private individuals and firms. Perhaps this accounts for the fact that Twin Beeches are used in greater numbers for Corporate Division Transportation than any other type, although there has been no major change in the airplane for 15 years.

The next most numerous type providing Corporate Division Transportation is the Douglas DC-3 or C-47. This airplane does not cruise nearly as fast as most of its users would like, and lacks other features they would specify in an ideal airplane for their uses, but the DC-3 does have certain advantages, such as relatively large interior cabin space, good short-field performance, etc. Its main advantage, however, has been that during executive aviation's recent period of rapid growth, it, like the Twin Beech, has been immediately available in quantity and at reasonable acquisition cost.

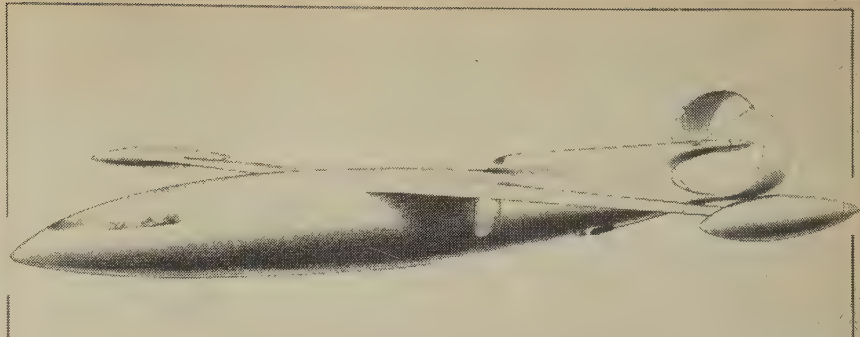
Third most popular airplane, numerically, in this classification is the Lockheed *Lodestar*, which is considerably faster than the DC-3, but provides less cabin space. Again, however, to the company seeking an executive airplane during the postwar years, the most important feature of the *Lodestar* was its availability.

Executive aviation has gained approximately 75% of its present stature in the period since the war, and by far the greater number of all airplanes used for Corporate Division Transportation are war-surplus airplanes which were originally built in quantities determined by the demands of the military. Therefore, in the case of each type, the number produced bears no direct relation to the demands of the executive market where so many of them are now being utilized. However, it is interesting to note that the number of each used for Corporate Division Transportation is in very close ratio to the total number of that type which has been available since the war.

The utilization of hundreds of these war-surplus airplanes having come about because of their immediate availability and in spite of the fact that they usually fail to measure up to all the user's wishes, indicates the strength of the demand by this group for some kind of executive air transportation. The extent of the demand is further illustrated by the fact that a sizable new industry has developed, largely since the war, to recondition, modify and maintain airframes and engines of airplanes primarily for Corporate Division Transportation, and to create and install suitable interior furnishings. Many basic modifications have been developed, improving the performance and utility of these airplanes, and executive interiors have been produced offering the comforts of a home, plus the work facilities of an executive office.

The equipment used for Corporate Division Transportation also includes a few converted wartime bombers which provide higher speeds at the sacrifice of other features, and a few hundred miscellaneous smaller twin-engine airplanes, such as the Lockheed 10's and 12's, the Aero *Commander* and the de Havilland *Dove*. The last two—the Aero *Commander* and the *Dove*—are the only important airplanes specifically designed since the war with the executive market as the prime target.

Almost without exception, the airplanes providing Corporate Division Transportation are extensively equipped with instruments and radio for blind flying. In many cases, these airplanes carry complements of the most modern equipment far in excess of that with which the average airliner is equipped. In almost every case flight crews are full-time professionals with the highest qualifications, most having heavy airline or military experience or both, and the occasional executive who is his own pilot must maintain his proficiency



Projected Executive Airplane Using Boundary Layer Control and Shrouded Propeller

FIG. 2

to professional standards. Airplanes and crews for Corporate Division Transportation operate with all-weather reliability equal to the airlines, and in some cases can operate when the airlines are grounded, through obtaining Certificates of Waiver allowing use of certain airports when weather is below minimums.

Corporate Management Transport

The third and final classification of executive flying supplies Corporate Management Transportation. Paradoxically, while the inclination and the financial ability to acquire fully adequate equipment are at the highest levels in this category, there exist for this group the fewest types from which to choose, and absolutely nothing fully meeting its needs.

The higher echelons of business executives are veteran airline travelers, and they wish their company planes to give them airline-calibre transportation. These top men are not likely to be satisfied with less than fastest airline speeds, which means 300 mph or better. With airlines offering non-stop coast-to-coast flights, Corporate Management wishes similar range. The executives at this level are usually middle-aged or elderly men, and it is essential that they do not become overly fatigued during trips, which means that all possible comfort features must be provided in their airplanes. In addition to the most comfortable, adjustable seats, there must be provision for sleeping on full beds or berths. There must be adequate space and headroom to walk about. Lavatory compartments must be reasonably spacious and must be fully equipped. Complete provision must be made for serving meals and hot and cold beverages. Cabin pressurization is highly desirable and for some whose health is fragile it is a definite requirement. Noise and vibration levels must be reduced to minimums.

In addition to measuring up to the best of modern airliners in these respects, the Corporate Management Transportation airplane must, like the Corporate Division ship, have better-than-airline instrument and radio complements. Also, since destinations will often be off-airways, at airports smaller than those usable by high-speed airliners, reasonable short-field performance is a requirement. Another feature often required is provision for doing office work enroute.

On the other hand, these airplanes do not have to match airliners in size and seating capacity. While there must, of course, be adequate interior space for the comfort features specified, there will rarely be requirements for more than 10 passenger seats. The primary reason for this is that, although executive airplanes have a safety record better than that of any other major means of transportation, large corporations are loath to allow more than a few members of top management to travel simultaneously in any conveyance whatsoever. Remote though the chance of such a catastrophe may be, the loss of a large number of top executives at the same time could be disasterous to even the largest firm. One of the nations very largest corporations has a firm policy forbidding more than 10 executives to travel together at any time in any single vehicle. Another specifies a maximum of four, and a third places the limit at only two.

Why are modern airliners not acquired by Corporate Management for private airline transportation? First,

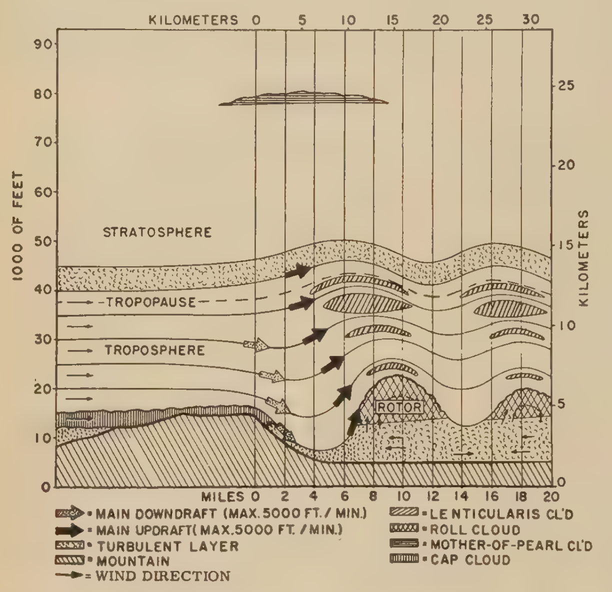
(Continued on Page 33)

Report details information available on structure of the mountain wave, the hazards of flying the wave, and the present methods of forecasting it

by C. F. Jenkins
Geophysics Research Directorate, ARDC

The Mountain Wave

FIG. 1—*Cross section of conditions associated with wave*



The purpose of this report is to give the field weather forecaster the latest and most accurate information available on the structure of the mountain wave, the hazards of flying the wave and the methods of forecasting it. The importance of the best possible forecast of a wave condition cannot be stressed too strongly, because it involves the most dangerous of flight conditions.

With regard to flight operations, the extreme turbulence, vertical currents and altimetry errors encountered in the wave combine to form hazardous flight conditions, and the present flight minimums are considered inadequate under wave conditions. Indeed, some accidents that have been attributed to pilot error, for lack of any other obvious cause, might have been prevented had the pilot been properly informed of the extreme hazards in flying a strong wave.

Figure 1 is a cross-section describing the conditions generally associated with a typical mountain wave. The dot-filled arrows indicate the position, relative to the mountains, where strong downdrafts occur. The solid arrows indicate the updraft area.

The cloud types *(shown in Fig. 1)* peculiar to the mountain wave are the cap (foehnwall), rotor or roll, lenticular and mother-of-pearl clouds.

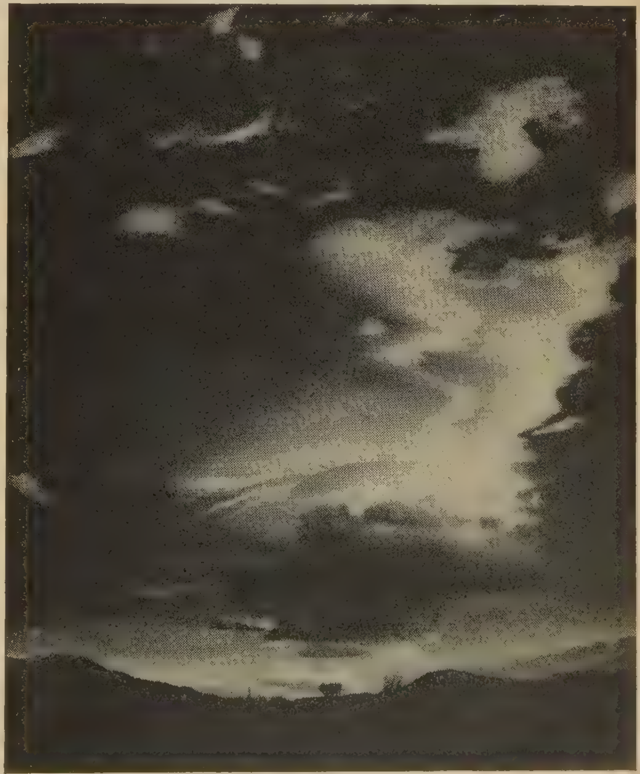
The cap cloud hugs the tops of the mountain and flows down the leeward side, giving the appearance of a waterfall. This cloud is dangerous because it hides the mountains and is in the strong downdraft area on the lee side of the peaks. The downdrafts can be as strong as 5,000 feet per minute.

The rotor cloud, which looks like a line of cumulus or fracto-cumulus clouds parallel to the ridge line, forms on the lee side with its base at times below the mountain peaks and its top extending considerably above the peaks, sometimes to twice the height of the highest peaks. The rotor cloud may extend to a height where it merges with the lenticulars above, extending solidly to the tropopause. While often appearing very harmless, the rotor cloud is dangerously turbulent with updrafts of up to 5,000 feet per minute on its leading edge, and equivalent downdrafts on its leeward edge, and there is a constant boiling motion in and below this cloud. In over-all shape and location, it is effectively a stationary

FIG. 2—*Photo (left, above) showing typical wave clouds was taken from the ground. The wind here is blowing right to left*
FIG. 3—*This photo (left) was taken from above same wave as Fig. 2. Note the horizontal extent of the rotor or roll cloud*

FIG. 4—*The Sierra range to the right, note downdrafts striking valley floor, kicking up dust and carrying it into rotor cloud zone. This is a case of an unusually long wavelength*

FIG. 5—*This photo (below) was taken on a day of extreme turbulence at high levels (39,000 ft.). Lenticulars show very rough edges. Cloud fragments moving across wave show turbulent motion*



cloud constantly forming on the windward side and dissipating to the lee.

The lenticular or lens-shaped clouds, which appear in layers sometimes extending 40,000 feet, are relatively smooth. The tiered appearance of these clouds is consistent with the smooth laminar flow in this section of the wave. The tiered type of structure is due to the stratified characteristic of humidity in the atmosphere and the lifting effect of the wave on the whole depth of the atmosphere. These lenticular clouds, like the rotor, are stationary, constantly forming on the windward side and dissipating to the lee. At times, severe turbulence is encountered above the extremely smooth lenticulars. The turbulence layers above and below the lenticular levels are comparable to ball bearings, allowing the atmosphere between to flow through at very high speeds. Occasionally, a breakdown of the laminar flow sets off the formation of severe turbulence throughout the whole depth of the wave. When this happens, the highest lenticular clouds show very jagged, irregular edges rather than the normal, smooth edges. The juxtaposition of very turbulent and very smooth flow is typical in the wave.

In most cases, the clouds tilt toward the mountain range as ascent is made through the layers from the rotor cloud to the highest lenticular layers. As a con-

FIG. 6—*Photo shows many heavy lenticular layers blanketing sky. Smooth texture, well-defined edges indicate laminar motion*

sequence of this tilting, the streamlines are packed close together in the downdraft side of the rotor. Thus, the wind speed is considerably increased in this area and local jets form, introducing an additional flight hazard.

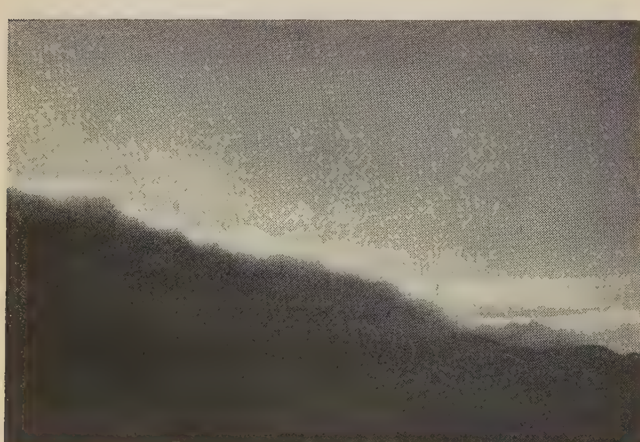
The dimensions of the wave can be tremendous. In the Sierra Nevadas, for example, the wave clouds can extend several hundred miles parallel to the ridge lines from a well-defined leading edge to the clouds. The wave clouds are visible from great distances and can provide the pilot with a warning of the existence of wave conditions.

There may be several wave crests or there may be only one. The amplitude and intensity of the waves decrease as you go downstream. The distance of the first wave crest from the mountain peaks varies with the wind speed, the type of wind profile and the lapse rate.

The roll cloud may be present anywhere from a position immediately to the lee of the mountain peaks to a distance 10 miles downwind. With a long wavelength, one might naturally assume that the lift zone ahead of the rotor cloud would taper off gradually. This, however, is not true. The updraft area is just as sharply defined as in shorter wavelength cases.

While the over-all context of the cloud formation

FIG. 7—*This is good photo of foehnwall (wind from left to right); note cloud affords complete coverage of mountain peaks*



is stationary over a considerable period of time, the clouds can change position, shape and structure in an extremely short time and there is continuously a considerable amount of motion in and around the clouds. Extensive clouds can form or dissipate in a matter of seconds.

There are times when the wind is favorable for a wave condition, but there is not enough moisture present for the clouds to form. This cloudless or "dry wave" gives just as much turbulence as when clouds are present but none of the warning features.

The strength of the flow during a strong wave may be from 90 to 150 knots (104-173 mph) in the upper troposphere. During the winter months, over a range like the Sierra Nevadas, waves can be expected on an average of eight to 10 days in each month, with two or three strong waves included.

Figure 2 is an "ideal wave" picture taken from the ground. The mountains are to the right and the flow from right to left. The foehnwall hides the Sierra Nevada mountain peaks to the right. The rotor cloud appears in the lower center portion of the picture with the lenticular clouds fanning out above.

Figure 3 is a picture taken from above the same wave. This picture shows the horizontal extent of the rotor cloud and the tops of this cloud merging with the lowest lenticular layers. Several lenticular layers can be seen to the right of the picture. The slopes of the Sierras are visible in the lower right-hand portion of the picture.

Figure 4 shows the range to the right with the downdrafts striking the floor of the valley, kicking up dust and carrying it up into the rotor cloud zone. This is a rather unusual long-wavelength case with the rotor zone very far back from the peaks. The dust shows how the flow hugs the surface and then rises sharply, just in advance of the rotor cloud, to 30,000 feet.

Figure 5 is a picture taken on a day when there was extreme turbulence at high levels. The high lenticulars in this case show very rough edges. Fragments of clouds moved rapidly across the wave showing turbulent motion.

Figure 6 shows many heavy lenticular layers blanketing the sky. The smooth texture and well-defined edges of the clouds indicate the laminar motion.

Figure 7 is a good shot of the foehnwall. It shows the complete coverage of the mountain peaks which this cloud affords. In this picture, the wind flow is from left to right.

A wave condition affecting flight operations arises with a component of the wind at a speed of 25 knots (28 mph) or more at the mountain-top level, flowing perpendicular to the mountain range. The actual wind direction can vary somewhat (with 50° being the maximum deviation from the perpendicular) and still cause a wave, but the strongest waves occur with a strong, perpendicular flow. The stronger the flow, the more severe the effects to be expected on the leeward side.

Any mountain range with crests of 300 feet or higher can produce a wave. Over low mountains the wave effect can be felt up to a height 25 times that of the range. The intensity of the wave is, in part, a function of the mountain height and the degree of slope of the mountain range, as well as the strength of the flow.

There should be a rapid increase in the wind speed with altitude in the level *(Continued on Page 46)*

by Harley D. Kysor
Aviation Consultant

Off-Airways Operation

Despite the fact that nearly all airports of considerable size and importance in the continental United States are connected by controlled airspace and the necessary air-navigation facilities, there may be times when off-airway flight is considered necessary by the business or private pilot to accomplish his assigned mission. It is the purpose of this paper to point out some of the major hazards and problems which may exist in off-airways operations and to suggest that they be carefully evaluated before decision is made to proceed off-airways. Where any question of safety arises through analysis of these matters, it is suggested that flight be routed via the Federal Airways. When it is necessary to traverse a considerable distance over uncontrolled airspace in order to reach the more remote airport, a consideration of these potential hazards may have an influence on the exact flight path to be followed or may make postponement of flight necessary in the interest of safety.

CAR 60.31 (d) requires that for VFR flight outside controlled airspace, flight visibility of one mile be maintained at all times. The cloud separation requirements of CAR 60.30 (b) must also be complied with during any flight specified as VFR (*i.e.* 2,000 feet horizontal and 500 feet vertical distance). However, the distinction between VFR and IFR flight off-airways is, in effect, nonexistent in the Civil Air Regulations since Part 60 prescribes no special IFR procedures as in the case of flights in or through controlled airspace. A pilot may "legally" take off, fly any distance in actual instrument conditions, and land without an Air Route Traffic Control clearance of any kind as long as he does not enter any controlled airspace while on instruments. He may continue flight on or across airways if he has three miles of visibility while inside the airspace boundaries and maintains the required cloud separation. There is only one regulation in CAR 60 which provides the pilot with any semblance of protection in the absence of Air Route Traffic Control. This is CAR 60.44 (b) which re-

CRUISING ALTITUDES OUTSIDE OF CONTROL AREAS AND ZONES

FIGURE 1

quires specific altitudes "appropriate to the magnetic course being flown". These altitudes should be followed to the letter, as they are the only legal requirement in existance today which tends to bring some kind of order and semblance of safety into what would otherwise be a hopeless tangle of converging traffic at the same altitudes. (*Fig. 1*)

From the foregoing, it is obvious that the hazards of mid-air collision on off-airway IFR flights are ever-present. The volume of air traffic of this type is, of course, unknown. Considering the number of military and civil aircraft in active operation, the potential collision hazard, if it could be calculated, would be no less than alarming. Although quadrantal altitudes offer some salvation, they leave much to be desired. First, they do not provide any altitude separation between aircraft operating on converging courses within the same quadrant or aircraft overtaking on identical courses; second, some pilots hold to their last assigned airways cruising altitudes or to their airways crossing altitudes in the mistaken belief that ARTC is providing separation for them off-airways at these altitudes. In fact, these altitudes are effective only for separation purposes in the controlled airspace, and the quadrantal rules apply immediately after the flight passes through the airspace boundaries. Third, it is regrettable, but true, that some pilots operating off-airways either forget or ignore the quadrantal regulations. It is suggested that business and private pilots refrain from conducting off-airways IFR flights whenever operations may be conducted almost as expeditiously, and certainly more safely, by adhering to the Federal Airways.

Pilotage is the normal method of off-airway navigation in VFR conditions. However, unless a route is well marked with readily identifiable terrain features, navigation by this means under weather conditions of 1,000-foot ceiling and three miles visibility or less can be extremely uncertain. If the aircraft is equipped with radio compass, course and speed checks may be obtained by tuning to commercial broadcast stations. In so doing, the pilot should be alert to the fact that lack of frequent identification of these stations makes possible erroneous tuning and the consequent misleading bearings. Three station fixes may also be obtained for position determination. The pilot should, in flight planning, plot the positions of these stations with reference to his course line if he intends to make use of them. A check of bearings against pilotage or dead reckoning position will reduce the chances of faulty tuning. For obvious reasons, pilotage should not be used as the sole means of navigation in doubtful weather conditions, particularly when the route to be traversed contains few recognizable landmarks. Instrument navigation off-airways may be accomplished with safety, provided careful study is made of the available navigation facilities. It should be pointed out that radio navigation coverage provided on the Civil Airways is subject to considerable testing for adequacy before the airways are commissioned. It is not expected that the business or private pilot be able to examine each proposed off-airway route for radio navigational coverage with the same degree of thoroughness. However, as a general guide in this matter, an information chart *(Fig. 2)* is submitted to be used in flight planning of off-airways

(Continued on Page 47)

Airspace Problem of TV Towers and Tall Structures

Discussion discloses immediate need for improving visibility of TV and tall towers, and making their locations quickly known to all pilots

JEROME F. LEDERER, a tireless worker for increased safety in the field of air operations, served as meeting's Moderator.

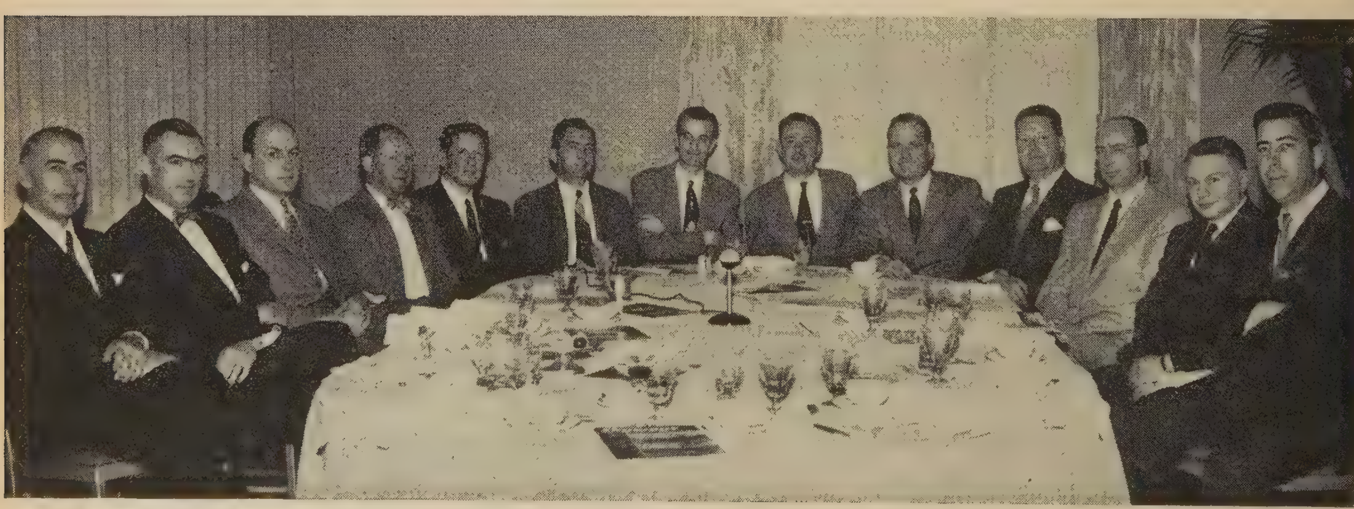
Moderator J. Lederer: "Before we get into the discussion, it might be advisable to state the aviation industry's position on this matter of TV towers. Here are pertinent excerpts from a letter on these towers from the Air Line Pilots Association.

'The Air Line Pilots Association has had representatives working on airspace sub-committee problems concerned with tower obstructions for some time. A great majority of times the airline industry positions have been maintained. However, as you know, every once in awhile a tower gets through without proper considerations. An example of this is the Kansas City television tower which was constructed off the end of the Kansas City Airport, under high political pressure. It seems to us that the CAA criteria is adequate but that problems concerning constructions which were in existence before the criteria was established and also some structures which qualified as being obstructions, according to CAA criteria, were passed anyway as a political expedient.'

"I also have a report from ALPA indicating that as of March 15th they hope to get their pilots to report to them on ALPA proposed policy 4-4 for the determination of the possible need for revising existing standards for marking and lighting tall structures supported by guy wires; and March 22nd is the deadline for comments on ALPA proposed policy 4-7, 'Aid to Air Navigation and Landing, U. S. National Standards on Obstruction Lighting and Marking'.

"Concerning the same problem, we have this from the Aircraft Owners and Pilots Association:

'Ever increasing numbers of unusually high television and broadcasting antennas are creating a growing hazard to all aircraft. AOPA participated in several meetings with the aviation and television industries to help plan the erection of these gigantic antennas, some as high as 2,000 feet, so as to create the least possible hazard to aircraft. While all participants in the conferences promised to give the highest priority to the safety marking of the vast expanse of nearly invisible guy wires necessary to support the giant towers, AOPA recently found many antennas going up without any special safety



TV TOWER ROUND TABLE *participants (left to right) were Hal Henning, General Motors; Bill Person, Flight Safety Foundation; Richard Dinning, ATA; Howard Higgins, N.Y. Airways; Jay Wright, CBS; Lou Burton, ACC; M. E. Phillips, CAA Region 1; R. E. L. Kennedy, Kear & Kennedy; Thomas Sullivan, Port of N.Y. Authority; L. G. Cumming, Institute of Radio Engrs; A. P. Walker, Nat'l Assn of Radio & Television Broadcasters; Moderator Jerome Lederer; and Rip Strong, pilot for Nat'l Dairy Products, who attended as an observer. R. M. Woodham, Cornell-Guggenheim Aviation Safety Center, came after photo was taken*

narkings of any kind on their guy wires.'

"In a letter to CAA, AOPA said, We feel that any approvals already given for such structures should be made contingent upon the availability of appropriate safety devices and markings, and that the ultimate structures would not in any case be approved unless such minimum safety standards were on it. We disagree strongly with the apparent CAA position that "safety can come later." As you know, these new TV antennas can very often be partly IFR and partly VFR, and the VFR portions, in addition to being narrow, hard-to-see shafts themselves, also will have huge networks of guy wires that are virtually invisible under the best condition, much less in borderline weather. At their base these guy wires can cover as much as 100 acres.'

"The CAA replied, 'As yet no effective and practical method of marking guy wires has been developed, and in the meantime the CAA is in no position to stifle the television industry by indiscriminantly disapproving all high towers they desire to erect. In fact, it is possible that the CAA would be over-ruled by higher authority if we attempted to do so. On this basis, the CAA has participated in approval of a substantial number of towers, most of which are below the 1,000-foot elevation above the ground, and their location is such that the approval was considered justified. In cases where guy-wire marking is considered desirable, every effort will be made to have it accomplished as soon as practical methods are available. In all cases, the towers proper are required to be marked in accordance with present standards both day and night. The CAA is concerned with the problem of improving the marking of tall towers and the supporting guy wires. We will continue our effort in this regard. If your organization has access to information concerning any new methods of obstruction marking of high towers and guy wires, or any recommendations to offer, we will be glad to discuss the matter with the hope that an effective and practical method can be developed.'

"Then the AOPA goes on to say, 'In the government-industry meetings on the subject, AOPA pointed out that the problem is a highly technical one and one which AOPA obviously is not qualified to solve. However, AOPA did suggest the use of large, lightweight aluminum balls like those used in Switzerland for many years to mark all types of wires or cables that present a hazard to aircraft. The tele-

SKYWAYS FLIGHT OPERATIONS ROUND TABLE

MAY 1954 | **Wings Club New York, N. Y.**

Round Table Participants

THOMAS M. SULLIVAN, Chief of Aviation Planning, Port of N. Y. Authority, is an Architecture graduate, Univ. of Okla. He began career with TWA.

A. PROSE WALKER joined the staff of Nat'l Assn of Radio & Television Broadcasters in 1953. Prior to that, he was Eastern Supv. of CONELRAD.

R. M. WOODHAM has spent over 27 years in aviation industry as designer, engineer and administrator; has been Adm. of C-G Safety Center since '51.

JAY W. WRIGHT is Chief, Radio Engineers, CBS-Radio and CBS-TV and operating stations WBBM-TV, KNXT, WCBS, WCBS-FM, WEEI, -FM, etc.

HOWARD HIGGINS, Chief Pilot for New York Airways, has logged some 4700 hrs in copters since he began flying them in '45; he was a test pilot.

R. E. L. KENNEDY is Chairman of Tall Tower Committee, Assn. of Fed. Communications Consulting Engrs. His firm represents many television clients.

WILLIAM P. PERSON, Managing Director, Air Transport, Flight Safety Foundation, is a former AAL pilot; maintains active Air Transport Rating.

M. E. PHILLIPS, Airspace Utilization Officer, CAA Region 1, began his career as a civil engineer with a consulting firm. He entered aviation field in 1932.

L. W. BURTON, Executive Secretary, Air Traffic Control & Navigation Panel, ACC, has been licensed pilot since '39. He is Lt. Cmdr in Naval Reserve.

L. G. CUMMING, Technical Secretary of Institute of Radio Engineers, has been actively engaged in radio, electronics since 1916; is Cmdr, USNR.

R. G. DINNING is Air Transport Association representative on the ACC/Airspace Sub-Committee; he has been member of Operations Staff since '49.

H. P. HENNING, Engineer-Check Pilot for General Motors Corp., has been an active pilot since '25, the past nine years with GM; has over 12,000 hours.

"TV TOWER *are difficult to see . . . they are narrow and frequently blend in with the landscape. Anything that can be done to make towers more visible would be an improvement," declared Hal Henning (left)*

"THE ACC *has no statutory authority with regard to taking final approving action as to location of tall towers," reported L. W. Burton. "Wherever possible, ACC believes location should be on common structure"*

vision engineers turned down the idea even though AOPA located a U. S. manufacturer for the balls.'

"This report then ended, *'On August 8, 1953 at 0730, George B. Taggert of Muncie, Pennsylvania, carrying a passenger, ran into the guy wires of a television antenna at Reading, Pa. Both were killed. The official weather at Reading Airport less than five miles away was 1200, scattered, visibility 10 miles.'*

"That gives you the position of ALPA, AOPA and the CAA. The position of the Air Transport Association is stated in the following:

'Generally speaking, I can point out that in the last three years over 1,000 applications for radio and TV antenna towers have been reviewed from an aeronautical point of view by the Airspace Sub-Committee of the ACC. These tower proposals involve the construction of towers ranging from 100 feet or less in height to 2,000 feet. The specific problems these towers have presented for airline operations have depended upon the location and height of the proposed tower. The towers can affect landing minimums, initial approach minimums, enroute minimums, radar vectoring, VFR operations during marginal weather conditions, or during conditions of ceiling ranging from 1500 to 2,000 feet. The extreme height of some of the proposed towers required a revision in the CAA instructions for the establishment of minimum enroute altitudes last year (1952). Furthermore, the large number of extremely high-tower proposals culminated in a complete review of the problem between the television and aeronautical industries during the summer of 1952.'

"This letter was dated October 30, 1953.

"Again, before we get into the discussion, I'd like to say that we're meeting here in a very constructive manner. We are trying to prevent a catastrophy before it occurs. That is a sign of intelligence on the part of those concerned with this problem.

"We might divide the problem into five or six categories:

1- Criteria for tower location and operation
2- Proper marking and lighting of towers
3- Prompt notice to airmen of tower locations and heights
4- The problems of frequency interference
5- Helicopter operations and high towers
6- The problems imposed by aviation on the TV people

"Before coming into this meeting, I met Hal Henning and we discussed this mattter. His thinking is so definite and so thorough that I feel he should lead off the discussion."

Hal P. Henning *(Air Transport Sect., General Motors Corp.):* "As I see it, the objective of the aviation, radio and television industries is to exist safely and economically while sharing the airspace. The aviation industry cannot take the attitude that it commands the airspace, nor can the radio and TV people. The problem then is, how do we live together . . . how do we avoid hitting or being hit without incurring ruinous costs. The possible solutions to that problem might be divided into two categories: visual avoidance and aural avoidance.

"Under visual avoidance would come more and better lighting of any obstruction in the airspace or any static structure that is using the airspace. Right now the aviation industry is working on a program of equipping aircraft with a high-intensity rotating beacon light to make aircraft more visible to other aircraft. Certainly, there are opportunities for improvement in the lighting of any of the static structures that occupy the airspace.

"Better painting is another possibility. These obstructions that are erected are very difficult to see. They are narrow and they frequently blend in with the landscape. Therefore, anything that could be done to find a better method of making the towers more visible would be an improvement.

"Adding mass is another possibility. Because of the narrowness of the tower, the mass is small and, therefore, difficult to see. The 'added mass' might be accomplished by grouping antennas in one location instead of having them in all directions around a city. A greater mass also might be accomplished by having plastic balloons anchored at the guy-wire anchoring points. These would form a square or some other shaped space that would be more visible. Certainly, adding mass to the structure would make it more visible in periods of smog, smoke or semi-fog.

"Previous knowledge of location of the towers would also be a solution, but that solution in itself brings up other problems, one of which is how to get the information disseminated to all the users of the airspace. A pilot may be operating out of a small airport where they do not have teletype NOTAM service or he may be using a Rand McNally road map to do his navigating by, or maybe an old Coast and Geodetic sectional. If that is the case, how do we get the information to him and how do we

"IDEA *of putting marker balls on guy wires was turned down by CAA," stated R. E. L. Kennedy (left, sitting next to Jay Wright)*

keep it up-to-date? The dissemination of information regarding these obstructions is a very real problem.

"A short while ago, I was on a trip departing Detroit for Lansing. We were to make a pick-up at Lansing to return to Detroit and then go on to Rochester and Syracuse, N. Y., and return to Lansing later in the day. We cleared out of Detroit on an IFR flight plan at minimum instrument altitude of 2300 feet. After our departure from Detroit City Airport, the weather at Lansing went below our minimums and we were forced to hold at our assigned altitude of 2300 feet above a thin stratus cloud deck at the Lansing Range station. There were three or four other planes holding in the same area. While executing the holding procedure, we looked over to one side of us and there, not very far off, was an antenna tower sticking up above the overcast. We called the Lansing Tower and asked about it. The Tower replied that it was a TV antenna, and when I asked if there had been any NOTAM on it, they replied that there had not. I've gone into Lansing many times and used that airway a lot, but the TV tower was new to me. I had never seen it before.

"When we got back to Detroit, I called the CAA Safety Agent and told him about the experience and asked if CAA was going to get out a NOTAM on it. He replied that it was the first he'd heard about it, but that he'd go right to work on it. Later that night when we returned to Lansing, we called the tower and they were putting out a notice in all communications to the effect that so many miles east-southeast of Lansing Airport there was this tower that extended so many

"HELICOPTER *operators like to move underneath the long-haul carriers," reported Howard Higgins (right), "but if we are restricted to minimum enroute altitudes of 3,000 or 4,000 feet, we are going to take a beating." Sitting next to Mr. Higgins is Richard Dinning*

feet above the ground. That came as the resut of its having been called to the attention of the CAA that morning. However, the structure required that the minimum enroute altitude along the airway from Detroit to Lansing be raised, and it also required a complete revision of the approach procedure to the Lansing Airport as well as a raising of the minimum enroute altitudes of other airways converging on Lansing. But all this was late . . . it came about *after* the tower was put there.

"To get back to categories, visual and aural avoidance, under aural avoidance might come a development suggested by a ham radio operator. He suggested a means by which a universal frequency blooper could be incorporated into any structure that exceeded a certain height above the ground, that would create an overriding tone on any radio that the aircraft might be listening to, in the 2 to 400 kc band, the entertainment band or the VHF freguency band. This suggestion was submitted to the CAA in Washington and, I'm told, the CAA technicians reported it had merit.

"Another idea that's been proposed is to put the 75 mc marker on the airways at the sites of any tall structures. However, I'm not sure that would be as universal in its usefulness as something else because not all aircraft are equipped with receivers for the 75 mc marker beacon.

"Above and beyond all this, however, is the need for complete dissemination of procedural information. I asked several agencies what the procedure was in the construction of an antenna tower, and was told that the applicant for a station license or permit goes to the FCC nd then the FCC refers him to the Airspace Sub-Committee which must pass on it. If the Sub-Committee approves the application, the FCC grants the permit. It may be a year or even two, or maybe just a few months, before the actual construction work starts. The applicant or station licensee is not required to do anything further until the structure is built to a height of 100 feet above the ground. At that time he is supposed to notify the CAA that the structure is going above 100 feet. Even when this procedure is followed, however, too little time is allowed for CAA to revise minimum enroute altitudes, approach procedures, and change charts.

"In conclusion, I think we all recognize that we are co-users of the airspace, that no one has a definite priority, and that the best attack on this problem is a coordinated and cooperative one, such as discussions of this sort, plus intra-industry publicity."

J. Lederer: *"Mr. Henning has shifted the responsibility to the CAA to answer some of the questions he's raised."*

M. E. Phillips *(Airspace Utilization Officer, CAA):* "Regarding the procedure Mr. Henning questioned, there is a definite requirement by law which makes it necessary that anyone proceeding with construction in the vicinity of an airport or near an airway, notify the CAA in advance of the time they start construction and give an estimate of the date the construction will start and an estimate of the date it will be completed. When we receive that notice, we pass the word on to the Safety Division of the CAA so that if minimum enroute altitudes, instrument approach procedures or any other procedures have to be changed, they will know about it prior to the time the construction reaches a critical point.

"In Region 1 we work so closely with the Safety people on these approvals that if procedures or altitudes have to be changed, they are made even before the construction starts. In addition, if the tower is located so that it is apt to be a hazard to operations, NOTAMs are also issued. The Coast and Geodetic Survey people receive their information from us at the same time our Safety people get it. Therefore, if the C&G consider it of sufficient importance, it can be shown on their charts."

J. Lederer: *"What steps do you take to see to it that the people who build the towers know these rules?"*

M. E. Phillips: "The requirements for that is in Part 625 of the Regulations of the Administrator of Civil Aeronautics."

J. Lederer: *"But those who build the towers don't see the CAR's."*

M. E. Phillips: "They know of these requirements through the FCC and through their contacts with us in the CAA at the time the aeronautical studies concerning the construction are made."

J. Lederer: *"It would appear that there is an educational program needed to spread this idea out further. It may work in Region 1, but apparently it does not work so well in the Region Mr. Henning referred to. However, we still have this problem of the location of the towers and airways utilization."*

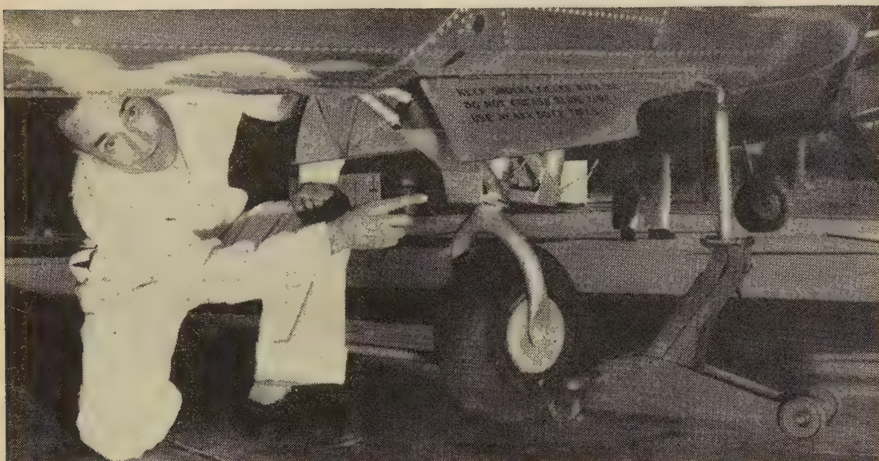
L. W. Burton *(Secy., Air Navigation & Traffic Control Panel, Air Coordinating Committee):* "The Air Coordinating Committee has no statutory authority in regard to taking final approving action as to the location of tall television, radio or other towers. The ACC represents the thinking and coordinates the recommendations among the various aeronautical agencies of the government (civil and military), and the aeronautical users of the airspace. As a general policy, the Airspace Sub-Committee of ACC believes that wherever possible the location of the antennas should be on a common structure such as, in the case of New York, the Empire State Building. If that's not feasible, then it recommends that a common location or television tower "farm" be selected which would present the least hazard to the operation of aircraft.

"Perhaps the television people who are here would answer the question as to whether or not the television

(Continued on Page 40)

SKYWAYS FOR BUSINESS

NEWS NOTES FOR PILOTS, PLANE OWNERS OPERATING AIRCRAFT IN THE INTEREST OF BUSINESS



PILOT *of Weyerhaeuser Timber's D18 points out the retractable guard he designed, manufactured and installed in front of tailwheel locking assembly. It keeps unit free of grit*

Sperry Opens Service Center at MacArthur Field, Long Island

Great Neck, N. Y. Sperry Gyroscope Company has opened a new aeronautical service center at MacArthur Field, L. I. The new center provides complete and rapid service on flight and engine instruments and automatic pilots for a large number of business aircraft now equipped with Sperry automatic controls or other flying aids.

Under the supervision of William Dooley, the new service facility is equipped to handle a variety of special service requirements. Complete test fixtures and trained personnel from the Sperry Flight Research Department are available to check radio communication and navigation equipment. In addition, ILS facilities are in constant operation and use for flight-checking equipment. Proper power supplies are available for ground checks.

Another feature of the operation is a comfortably furnished pilot's ready room with adjoining showers and a recreation room. The ready room is equipped with teletype for weather information, wind direction and velocity indicators, and a large radio facilities chart for the U. S. and Canada.

Cowl Flap Hinge Modification Proves Successful on D-18S

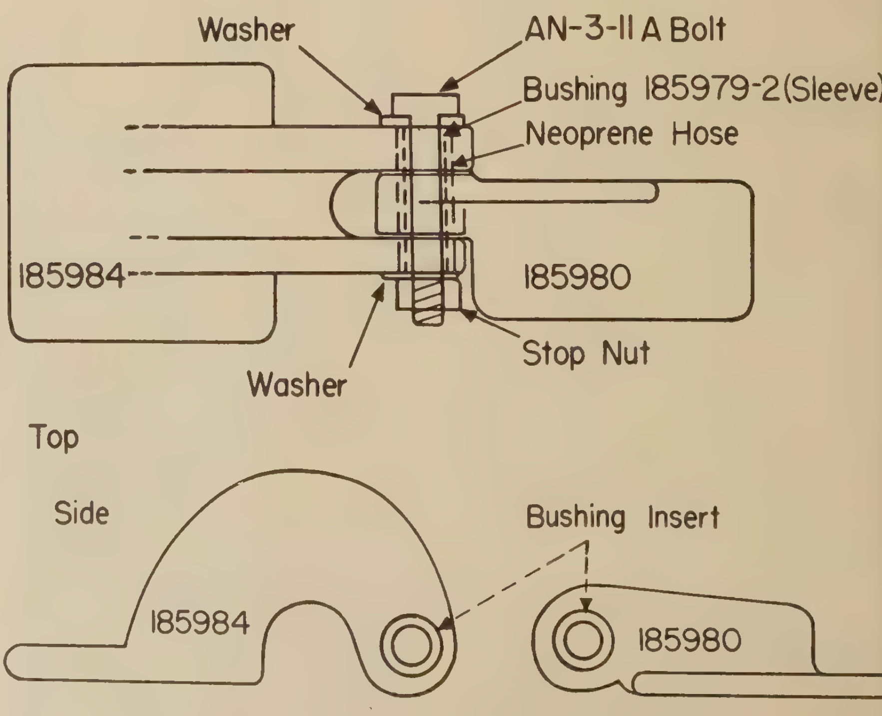
New York, N. Y. In a letter to Skyways from Dallas, Texas, Louis A. Labe, an executive pilot for The California Company, reports another successful Twin Beech cowl flap modification (*right*), this one to minimize maintenance of the hinges. These hinges suffer quite a bit of vibration wear and often must be removed and replaced, all of which involves a lot of rivet work. Several Twin Beech operators in the south and southwest have used the following modification and report it to be highly satisfactory: Remove the bushing insert from the hinges, parts 185984 and 185980. This can be done easily when replacing the old hinges. Drill out the holes (from which the inserts were removed) with a "U" drill .3680 diameter. When assembling flaps, insert a piece of neoprene hose (no cord) 3/8th inch O.D. and 1/4 inch I.D., cutting a trifle long so that it will form a washer on the outside when it is pulled tight. Insert the sleeve, Beechcraft bushing #185979-2, through the neoprene hose; then use AN-3-11A bolts with elastic stop nuts and appropriate washers.

Mr. Labe reports this modification has been used on his company's Twin Beech; was made on their airplane by D. A. Cody, Service Manager of the J. R. Gray Co, Inc; and has proved very satisfactory. After over 200 hours, Mr. Labe stated, the cowl flaps should still be very firm and further maintenance requires only the replacement of the neoprene hose.

Retractable Tail Wheel Guard Protects Assembly from Grit

Tacoma, Washington. Ingenuity has saved many a dollar in the business-aircraft field, and to the pilots and mechanics of these aircraft goes the credit for making such profit extra's possible. A. J. "Nappy" Wildhaber, pilot of Weyerhaeuser Timber Company's Twin Beech, is a case in point.

Wildhaber discovered, while operating off unpaved runways, that it was very important to keep the tail wheel locking unit, bronze plates and retractable slide tube free of grit, gravel and other foreign matter. He, therefore, designed, manufactured and installed a retractable guard in front of the tail wheel locking assembly (*see photo*). Wildhaber's innovation is shaped from 24-S-T .040 material and mounted on the A-frame of the retraction assembly with #6 screws. He also removed the slide tube, chrome-plated it and then set it back in place. In replacing



Engine Cowl Flap Hinge

the A-frame, he added four steel washers to secure the thrust sleeves on the hinging action.

This successful tail wheel guard is not the only innovation worked out by Mr. Wildhaber. His others include lagging (with woven asbestos painted with soda silicate) the manifolds to the carburetors to improve control over carburetor icing; and installing a baffle across the front of the belly center section panel. This eliminated in-flight buffeting action between the front fasteners and denied entry to the moisture that had been coming through the leading edge of the panel when flying through heavy percipitation.

New Heating and Ventilating System Installed in Commanders

Bethany, Okla. A new heating and ventilating system has been installed in the Aero *Commander* which promises to provide much better passenger comfort in both winter and summer. Better heating has been brought about by the mounting of the Janitrol S-25 combustion heater in the nose. This gives a better air flow through the system than was obtained in the previous system which had the heater located aft of the baggage compartment. There is also a more even distribution of heated air through the cabin, with special attention being given to the pilots. A constant temperature level is obtained in the cabin and better windshield defrosting is possible with the increased circulation of heated air upward from behind the instrument panel.

For summer operations, comfort is increased by a new fresh-air ventilating system. This system intakes fresh air through an air scoop above each pilot's window. This air is then ducted along the top of the cabin on each side to six individual vents at each seat location. Fresh-air vents are also located in the lower forward cabin wall. Each vent is individually controllable.

United Aircraft is $1,650,527 Yearly Customer of Airlines

East Hartford, Conn. United Aircraft Corporation's recently released report of its expenditures during 1953 for commercial airline travel disproves the contention that companies owning and operating their own aircraft for business do not use the nation's commercial airlines.

H. M. Horner, president, reported that during 1953 United Aircraft spent $1,650,527 as a customer of the commercial airlines. This sum represents an increase of nearly $173,000 over the amount spent in 1952 by the corporation, its four divisions and its subsidiaries for air passenger travel, air freight, air mail, air express and air parcel post. Passenger travel took the major share of the costs with an expenditure of $1,007,513.

United Aircraft employees flew more than 17 million passenger miles on business. The necessity for speed made air travel essential, Mr. Horner said, and enabled representatives to fly to and from their destinations with incalculable savings to the corporation in both time and money.

....in the Business Hangar

John Lambert has U. S. Rubber Company's DC-3 flying again after an engine change by Atlantic Aviation at Teterboro, N. J.

Roscoe Turner Aeronautical has opened a branch operation at Hulman Municipal Airport at Terre Haute, Indiana.

Ralph H. Cuthbertson, chief pilot for J. P. Stevens & Co., New York, recently had each of the company's D-18's in the Airmar Radio Service shop at MacArthur Airport for complete radio overhaul and the installation of Collins 51R-3 receivers and 17L-3 transmitters. The aircraft are based at Greenville, South Carolina, and Mr. Cuthbertson is his company's NBAA representative.

A Convair 340 belonging to Consolidated-Vultee, one owned and operated by The Texas Co., and a third owned and operated at Union Carbide and Chemical Corporation have been in the AiResearch Aviation Service hangar for installation of executive interiors.

The DC-3 used by Gulf Research and Development for aerial magnetometer work has been at Executive Aircraft Service, Dallas, for a double engine change, 100-hour and annual inspection and miscellaneous repairs.

W. J. Holliday & Co., Indianapolis, recently took delivery of an E35 Beech *Bonanza* with a 225-hp Continental engine. Roscoe Turner Aeronautical installed a Lear Autopilot, a Narco Simplexer, and an ARC Omni.

C. B. Owens, Jr. delivered the Smith-Douglas Lockheed 18 to Lockheed Aircraft Service at N. Y. International Airport for tank inspection and miscellaneous services. Owen is chief pilot and his company's NBAA representative. Home base is Norfolk, Va.

The Twin Beech belonging to the Whirlpool Corp., St. Joseph, Mich., is in the Roscoe Turner Aeronautical hangar for installation of a 22-channel simplex control VHF transmitter and receiver, being assembled by Turner's radio shop.

S. W. Richardson's DC-3 is back in operation after 100-hour inspection and new ball bearing cowl flap linkage assembly. The work was done by Executive Aircraft Service. The company's chief pilot is Ed Armstrong.

Atlantic Aviation, Teterboro, is modifying the interior of National Distillers' B-23 and installing a new three-place couch built by Atlantic Aviation. Harold Curtis, National Distillers Products pilot, brought the B-23 to A. A.

L. M. Lacey, chief pilot for Triangle Conduit and Cable Co., has just had a Collins 51R-3 and 17L-3 installed in his company's PV-1. Airmar Radio Service did the work at its MacArthur Airport base of operations.

A DC-3 belonging to National Cash Register Co., Dayton, Ohio, and a B-23 owned and operated by H. C. Price Co., Bartlesville, Okla., are being given new executive interiors and exterior paint jobs by AiResearch Aviation Service.

Hydraulic Press Manufacturing Company's chief pilot, Warren Gray, recently flew the company's Twin Beech to Roscoe Turner Aeronautical's Indianapolis base for a 1,000-hour inspection, engine overhaul, and the installation of additional ARC radio.

Levon Fireston, one of Union Producing Company's pilots, is flying one of the company's *Lodestars* after a double engine change, 100-hour inspection, installation of a new custom cabin divan, and refinishing work by Executive Aircraft Service.

Performance PITFALLS

from the Files of the Flight Safety Foundation

by Jerome Lederer and Robert Osborn

WHAT'S MY RATING

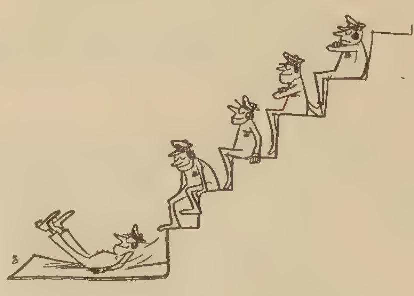
In analyzing nine accidents of the type referred to as "Position Unknown," five important points were brought out:

1. Seven of the nine occurred during hours of darkness, and five of these were between the hours of 0100 and 0500.
2. Evidence indicated that in seven out of the nine cases pilots appeared to be in an undue hurry to avoid ATC delays or to avoid spending the necessary time required to work a standard instrument approach.
3. In four out of nine accidents, evidence indicated that an attempt was made to fly VFR where intermittent instrument conditions existed. Two of these were in rain showers at the time of impact, and one was in a solid overcast.
4. A contributing factor in four of the nine was error in identification of position over a fix. In one of these it appeared that descent was started after oral but not visual identification of a fan marker.
5. Six of the nine accidents occurred during initial descent. The other three were flying airway segments below authorized minimums.

One thing is clear, a pilot's responsibility is the efficient use of his avionic equipment and an understanding of its limitations. Considering this efficiency, the nine accidents mentioned present a question: "Is efficiency of a pilot affected by intangibles such as sleepiness, worry, fatigue, preoccupation, distractions, etc? If you answer "yes" to that question, do you believe that these intangible factors can be best brought under control only through self discipline? Try the following test and rate yourself as a Professional Pilot

	Yes	No
1. Do you obtain sufficient rest to avoid sleepiness on all flights?	___	___
2. Do you set personal problems aside when flying so as to eliminate any preoccupation?	___	___
3. Do you fly in accordance with VFR when instrument conditions exist?	___	___
4. Do you consider the oral fan marker signal as accurate as the visual signal when determining your position over a fan marker?	___	___
5. Do you anticipate your time over the next fix during instrument departures and approaches?	___	___
6. Do you check the identification of each radio facility used?	___	___
7. Do you operate in a coordinated cockpit where all crew members have an understanding of respective duties in regard to emergencies, radio tuning, missed approaches, etc?	___	___
8. Is your judgment ever influenced by being in a hurry?	___	___
9. Do you always fly in accordance with your ATC clearance?	___	___
10. Are all members of your crew constantly alert to avoid collision, particularly during climb and descent?	___	___
11. Do you subscribe to approved minimums?	___	___

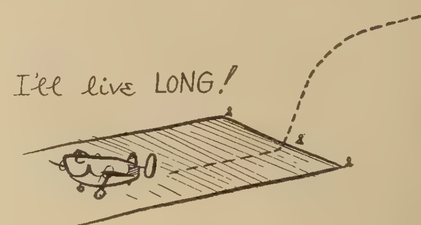
For maximum safety, each of us should be able to answer all of the above questions correctly.



RATE OF DESCENT

The CAA has asked the following information be publicized in order to insure standard vertical separation at all times between holding aircraft.

Unless otherwise advised by the controller, Air Traffic Control expects that aircraft will descend in holding patterns in accordance with standard procedure at the rate of 500 feet per minute. Upon receiving a report that an aircraft has vacated an altitude in descent, a clearance may be issued to the next aircraft above to descend to the lower altitude. Should the higher aircraft be capable of more rapid descent that the aircraft below, a less than 1,000-foot vertical separation could very easily result. Therefore, pilots desiring to descend at a rate in excess of 500 feet per minute should make this fact known to the controller and obtain his assurance that it will *not* result in conflict with other aircraft below. In some instances controllers might anticipate this desire and so advise a particular flight. Therefore, it is suggested that you *check with the controller* at all times before descending either in excess of 500 feet per minute or at a lesser rate than 500 feet per minute.



APPROACH APPREHENSION

A mishap occurred not too long ago which indicated, according to the available information, that a pilot was attempting to make a three-engine emergency landing. He apparently overshot the runway and came to grief in trying to pull-up on the three engines.

From this it would seem that sufficient attention and training is not given to crews to teach them to land as short as possible at all times. All approaches to the runway should be made on the assumption that the hydraulic system is not operating and no flaps or brakes are available. At no time should the brakes or flaps be relied upon to slow the airplane after landing.

There was a time when brakes on an aircraft were used only for maneuvering on the ground. However, since the advent of heavier aircraft and higher landing speeds, the brakes are used more and more for slowing the airplane after touch-down. Unfortunately, this has developed into a very undesirable condition, particularly for the lighter aircraft. It has made the pilot depend too much on the brakes and, even though his landing may be a little on the long side, he never worries too much because he knows he can use the brakes for stopping.

Perhaps a good idea would be to expect all pilots on their final checks to demonstrate their ability to land short, regardless of the type of aircraft they are flying. These demonstrations should be carried out without the use of flaps or brakes.

Official NBAA Report

NATIONAL BUSINESS AIRCRAFT ASSOCIATION, INC.

(formerly Corporation Aircraft Owners Association)

National Business Aircraft Association, Inc. is a non-profit organization designed to promote the aviation interests of the member firms, to protect those interests from discriminating legislation by Federal, State or Municipal agencies, to enable business aircraft owners to be represented as a united front in all matters where organized action is necessary to bring about improvements in aircraft equipment and service, and to further the cause of safety and economy of operation. NBAA National Headquarters are located at 1701 K Street, N. W. Suite 204, Washington 6, D.C. Phone: National 8-0804.

Cleveland Air Traffic Committee Reports on Recent Meeting

Chief Pilot Bob Sheriff of Thompson Products, Cleveland, Ohio, NBAA's representative in that area, has submitted the following report on the recent meeting of the Cleveland Air Traffic Committee.

"There was a large attendance, including representatives from the NBAA, Airlines, Air Force, Navy, National Guard, INSACs, Control Towers, Control Centers, Erie Ordinance Depot, private, and business pilots.

"The minutes of the previous meeting were reviewed and it was agreed that:

1. The inauguration of low-altitude control (altitudes up to 5,000 feet are turned over to Approach Control) in the Buffalo, Rochester, Syracuse, and Elmira area has been satisfactory.
2. Re-alignment of the Pittsburgh and Akron ranges, plus the use of V-116 Airway (New York-Chicago) has aided the Cleveland area in the "over" traffic problem.
3. Action was under way by FCC to limit the height of radio and TV towers near airports.
4. Radar departures for the Cleveland area to be implemented soon.

"The problems brought up for open discussion were:

1. The release of low altitudes from Approach Control to ATC during slack hours—2300 to 0700 hours. Participants agreed to this sensible suggestion.
2. Bradford, Pa. under instrument conditions brought up the following problems:
   a. Bradford is not in a Control Zone, therefore approaches below 700 feet are unprotected from VFR traffic.
   b. No suitable means of communications to issue clearances.
   c. Due to terrain, airplanes below 5,000 feet lose radio contact with nearest INSAC stations.

Recommendations

   a. Re-apply for establishment of Control Zone in Bradford Area.
   b. Have ATA discuss with airlines possible establishment of INSACs or suitable communication facilities.
   c. In the interim, designate one INSAC station to contact for Bradford.
3. The Akron Area: The abolishment of Red Airway 57 between Akron and Youngstown was suggested to allow simultaneous use of V-43 and Airways B-15 and G-3, thereby providing lateral separatioin at the same altitude. The need for additional holding patterns in the Akron-Canton area was discussed and it was agreed that simultaneous holding fixes should be adopted at the Canton-Akron ILS Outer Marker and the Akron range.
4. A warning was issued to all pilots concerning danger area 149 which is northeast of Toledo, Ohio and is shown on the Cleveland sectional chart. The Erie Ordinance Depot advises that during a 20-day period, 120 violations of this airspace were recorded. The danger area is extremely active with all types of gunnery. All concerned must stay clear.
5. Preferential Routes: All pilots' are requested to use preferential routes when filing instrument flight plans in the Cleveland Area. Further information relative to these routes can be had by contacting Mr. Walt Dalglish, Chief of Cleveland Airway Traffic Control."

CAA Requested to Clarify Take-Off, Landing Minimum Rules

NBAA's request to the CAA for clarification of rules applicable to take-off and landing minimums for business aircraft operations resulted in issuance of a comprehensive explanation of this problem.

Two Sections of Civil Air Regulation 60 apply: Section 60.42, which prescribes minimums for airports to be listed as alternates in IFR flight plans, and Section 60.46, which directs the Administrator to prescribe standard instrument approaches. Nowhere in CAR 60 is the matter of take-off minimums mentioned. In fact, Sections 60.30 (A) and 60.31 (B) permit flights in a control zone without respect to weather minimums if traffic conditions permit and ATC clearance has been obtained.

Under authority of Section 60.46, standard instrument approaches have been prescribed and published. The standards by which these procedures are established are set forth in Part 609, Regulations of the Administrator. In view of the absence of any mention in CAR 60 of landing minimums at the airport of intended destination, Part 609 has specifically provided for them. This was predicated on the assumption that they were a part of instrument approach procedures, and was done with concurrence of the Civil Aeronautics Board.

The reason why air carriers have take-off minimums in addition to landing minimums is that CAR's 40, 41 and 42 specifically prescribe both.

In light of this, the specific answers to NBAA's questions were:

1. The take-off minimums set forth in the Flight Information Manual do not apply to non-air carrier operations.
2. Unless otherwise authorized by the Administration under a certificate of waiver or authorization, the landing minimums set forth in the Flight Information Manual apply to all non-air carrier operations. These minimums are also applicable to irregular air carriers, commercial operators, and air taxi operators unless authorized in their operations specifications.

TV-Radio Tower Obstruction Lighting Studied By ACC

The Air Coordinating Committee has established a Special Working Group under chairman J. D. Blatt, CAA, to study the over-all subject of lighting and marking of radio and television towers and other tall structures. The program has been divided into two phases, both involving public hearings and correspondence with other government agencies and civil scientific, aeronautical, and trade associations. The NBAA has persistently urged the ACC to form such a committee in the interests of air safety, based on a number of complaints from members who have had "near-misses" with tower supporting cables during conditions of poor visibility.

The group is soliciting industry views on the adequacy of present methods of marking to determine if it is necessary to alter current standards. If so, the second phase involves a study of methods by which markings can be improved.

New NBAA Members

1. Sundstrand Machine Tool Co., Rockford, Illinois. NBAA Representative—Howard N. Riddle, Pilot. Company operates Riley *Twin-Navion*, two's Beech *Bonanza.*

2. The Charles B. Knox Gelatine Co., Johnstown, New York. NBAA Representative—John B. Knox, Treasurer. Company operates Grumman *Super Widgeon.*

3. Jack Cage & Co., Inc., Dallas, Texas. NBAA Representative—Andrew W. Stirton, Chief Pilot. Company operates D-18's.

4. Mountain States Aviation, Inc., Denver, Colorado. NBAA Representative—Harry B. Combs, President.

5. Purdue Aeronautics Corporation, Lafayette, Ind. NBAA Representative—Frederick L. Hovde, President. Company operates three Douglas DC-3's.

6. Air Associates, Teterboro, New Jersey. NBAA Representative—Irving R. Ackerman, Pilot. Company operates *Commander.*

Engineers mount cameras and X-wing on supersonic rocket to test new design.

On California desert, rocket begins flight reaching 3 times the speed of sound.

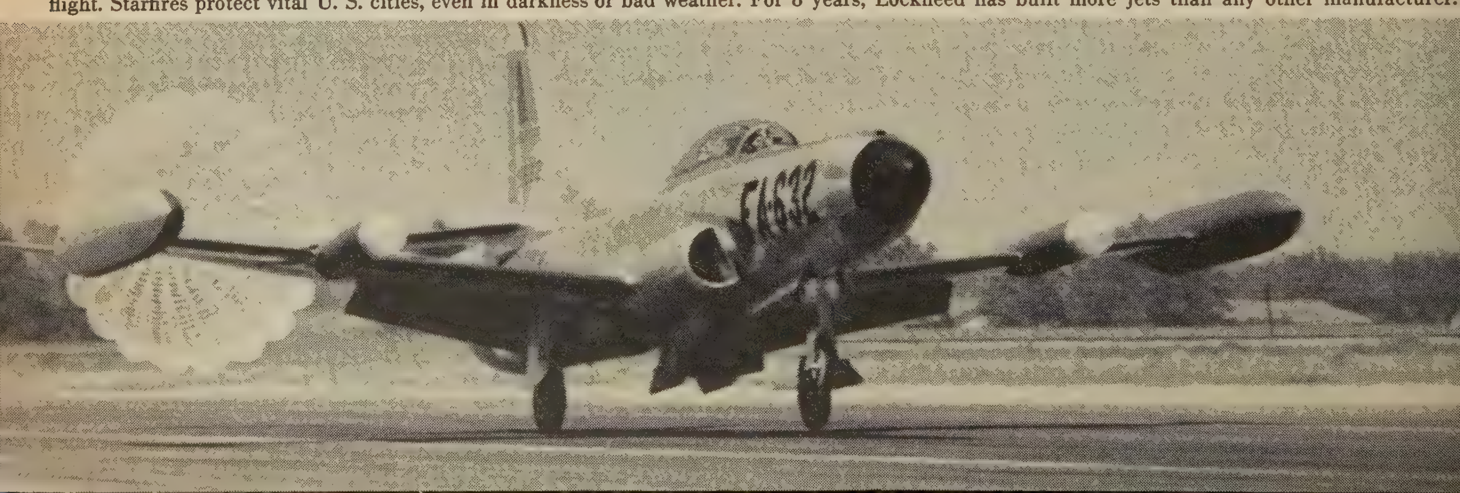
Desert craters fade away as camera records speed effect on new experimental wing.

Here, another wing desi flaps violently from the pre sure of the supersonic spee

Lockheed Scientists Shape the Forms of

Lockheed's Expanding Science Center Improves Today's Planes and Develops New Designs fo

FIRST IN THE NATION'S ALL-WEATHER DEFENSE. Lockheed F-94 Starfires are jet interceptors loaded with electronics for almost automatic flight. Starfires protect vital U. S. cities, even in darkness or bad weather. For 8 years, Lockheed has built more jets than any other manufacturer.



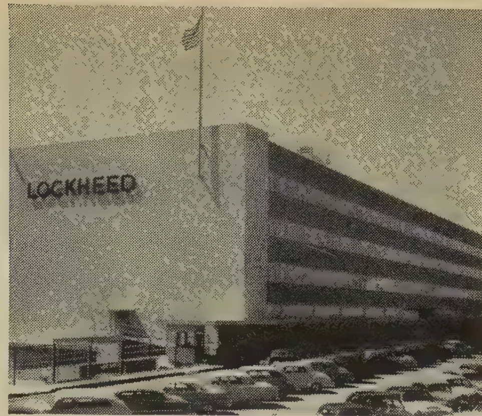
...rachuted to earth, rocket
...nera is recovered with
... data vital for the future.

...ture Flight

...ra of Automatic Flight

...e film strips take you behind the ...o show Lockheed scientists test- ... wing designs for future aircraft ...nes faster than today's. This is ...ple of advanced research at Lock- ...xpanding Science Center. Scien- ...neers work with nuclear energy, ...aircraft, electronics systems, new ...r the era of automatic flight.

...eed discoveries in *pure* science ...ched by Lockheed progress in ...cience. Lockheed's science of de- ... produced a radar-laden team of ...g military aircraft—flying radar ... almost automatic interceptors, ...marine patrol bombers. Skill in ...f production enables Lockheed to ... 12 different models simultane- ...nd all models are on schedule!

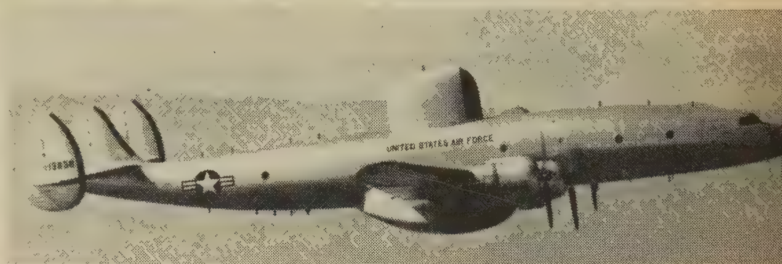


SCIENCE CENTER — *Future forms of flight are studied here in Lockheed's new Engineering and Science Building.*

Announcement

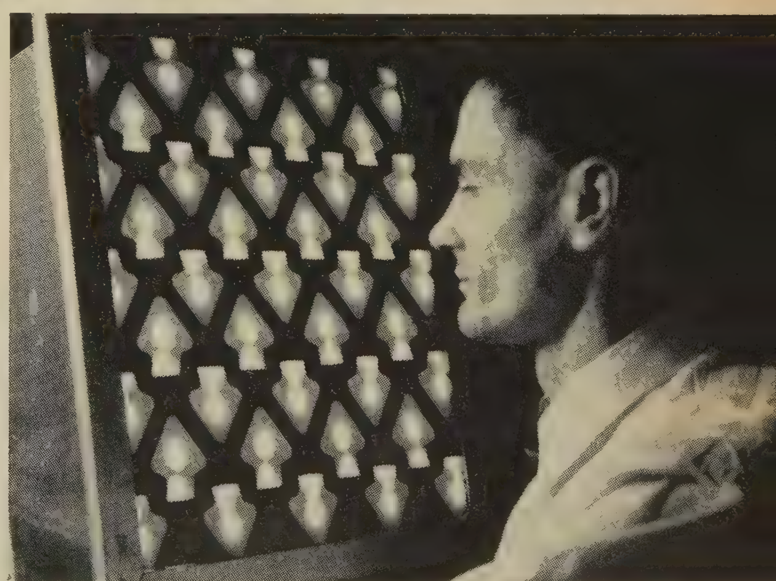
Important news in the U.S. aircraft industry this month was establishment by Lockheed of a new Missile Systems Division, a separate organization integrating 10 years of research and development in the field of electronics and pilotless aircraft. Important progress in current top-secret work at Lockheed prompted decision to establish new division in expanding field of automatic flight.

FIRST! FLYING RADAR STATION. Lockheed Super Constellations, with radar humps, provide Navy and U.S.A.F. with new concept of defense—a new method of detecting an enemy hours in advance through applied electronics.



FIRST! ELECTRONIC SUB PATROL—Advanced models of Lockheed P2V Neptune Bombers give U.S. Navy long-range sub patrol with destructive power and advanced sonic devices.

TOMORROW'S METALS. Planes 10 to 25 years from now, currently under study by Lockheed, will require new materials to withstand tri-sonic speeds. Here, Lockheed scientist checks X-ray film of new metal.

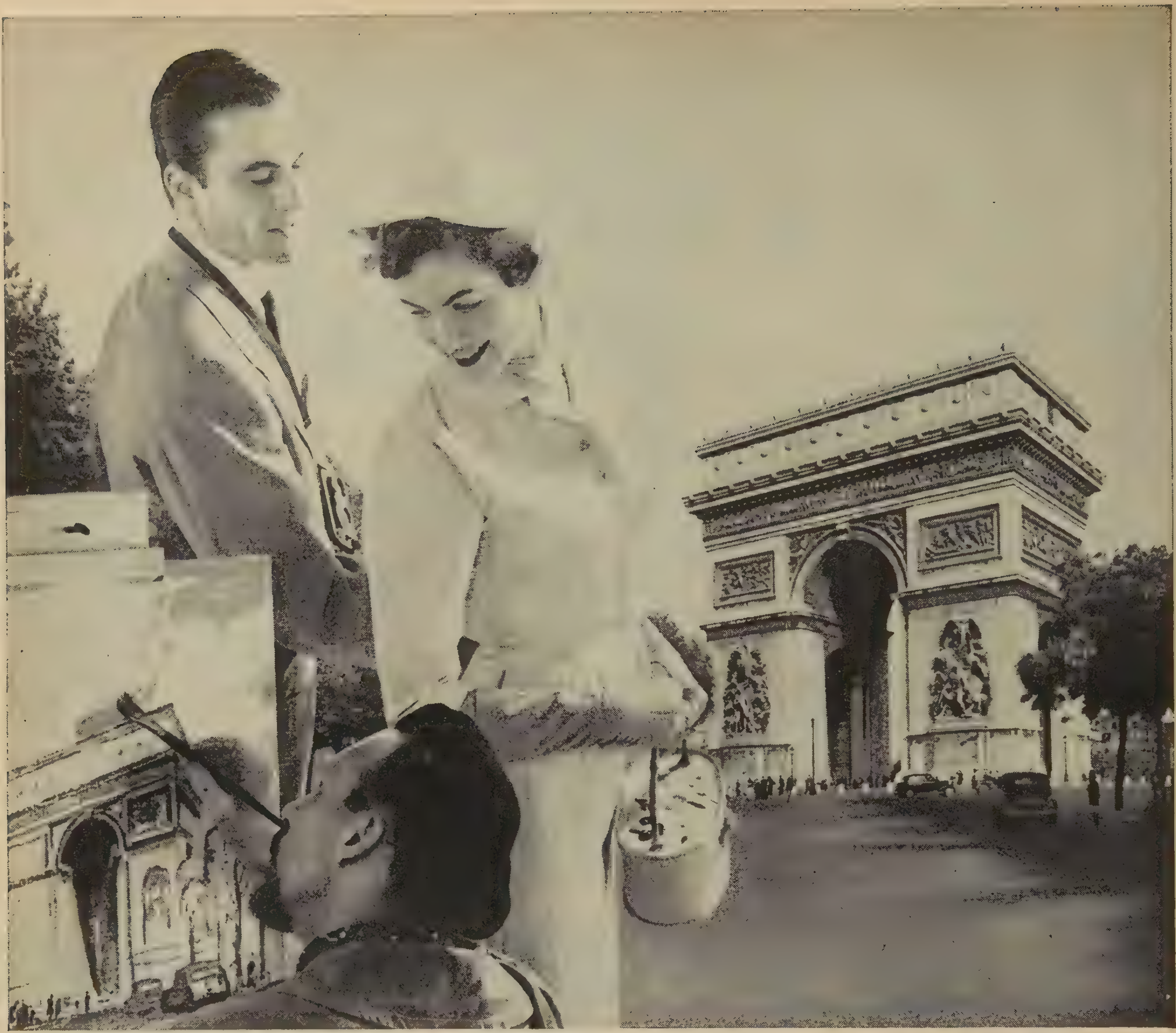


COMING SOON—*Look for other dramatic new Lockheed models soon, including XF-104 Day Superiority Fighter.*

Lockheed

Lockheed Aircraft Corporation, Burbank, California, and Marietta, Georgia

LOOK TO LOCKHEED FOR LEADERSHIP



Let TWA's wings work wonders with your vacation

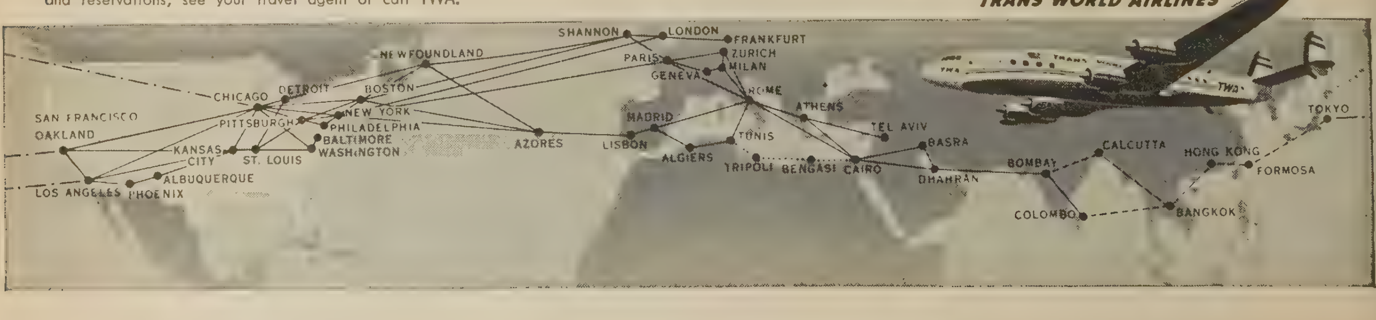
The Champs-Elysées—so beautiful you want to reach out and hold all Paris in your arms. Yet only last night you were winging your way across the Atlantic in a swift TWA Constellation—dreaming of all the promised pleasures and sights of your long-awaited vacation. Tomorrow, new discoveries in France. Next week, Italy. But you've already made the biggest vacation discovery of all . . . the magic of TWA—of wondrous Constellation wings and thrifty Sky Tourist fares that can make your vacation dreams come true anywhere in the world—even in as short a time as 2 weeks!

Visit 16 cities—9 countries in Europe for the fare to one! Stop over in any or all of the cities shown on the map above. Pay only the round-trip fare to Rome!

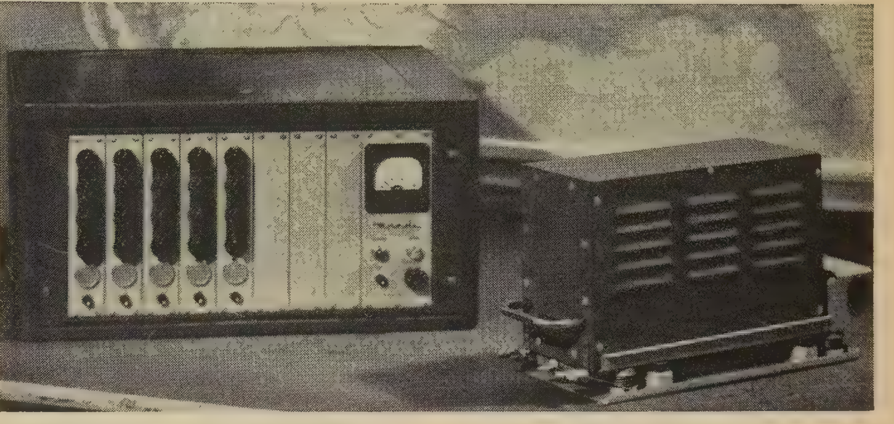
Where in the world do you want to go? For information and reservations, see your travel agent or call TWA.

Fly the finest . . . FLY TWA

TRANS WORLD AIRLINES



Motorola and Bendix "Selective Calling" Reduces Pilot Burden



MOTOROLA 'SELCAL" *(above) enables operators to keep in close touch with airborne crews*

One of the greatest drags on cockpit efficience has been the necessity to aurally monitor several radio channels simultaneously under circumstances where the navigational and communications channels are of necessity separate. Safety of navigation and air traffic control requires airborne crews to diligently monitor the appropriate associated frequencies, especially during periods of instrument approach and whenever approaching or departing from a high-density area. This has necessarily deprived airline and other operators of close contact with and knowledge of the operational status of their aircraft. In some instances, company policy has demanded that the already overburdened crews monitor a company frequency simultaneously.

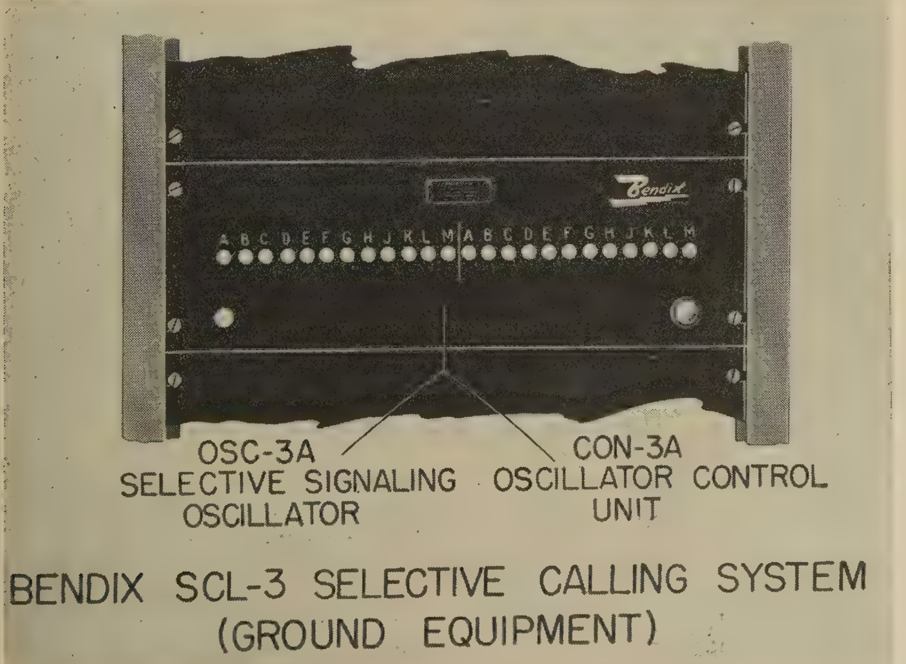
Considerable emphasis has been placed in designing simplification and standardization into aircraft cockpits to reduce the work load imposed by instrumentation and controls. Now, two leading manufacturers of aircraft radio equipment have announced the introduction to the market of "selective calling" systems designed to reduce the communications work load. Motorola and Bendix report that their newly developed tone-coded selective signalling systems will enable both airline and other commercial aircraft fleet operators to maintain contact with airborne crews while the latter devote their exclusive attention to the required navigational and ATC channels.

Both systems, identified respectively as Motorola's Airborne "Quik-Call", and the Bendix SCL-3, function similarly to established ground systems such as the land-marine two-way telephone systems where either a light or buzzer-bell device alerts the desired receiving party's attention. Thus, constant monitoring of the associated radio channel with its constant background noise and chattering of distracting irrelevant communications, is done away with and if ATC is not involved, earphones or speaker can be hung up or muted. Concentration on the navigational problem at hand can be exclusive.

Although primarily designed for and developed in cooperation with overseas aircraft operators, the Selective Calling systems have a wide application to domestic airline and commercial fleet operators. Its uses for pipe-line, forestry and range patrol are obvious. Mapping, survey, and working-executive transportation and parts haulage as well as feeder and taxi services can easily find advantages to such a development without sacrificing safety and efficiency of operations.

The Bendix transmitting unit comprise 12 vacuum tube audio oscillators whose frequencies are controlled by resonant vibrating reeds. The oscillators are halves of dual triode type 12AU7 tubes. The reeds are of the plug-in type for easy replacement. A set of 24 push buttons is used to produce more than 1400 tone combinations. These fundamental tones are in the audio frequency range between 312.6 and 977.2 cycles per second.

The pulses of pre-selected frequency combinations are produced when the activating switch is pressed. Each pulse has a duration of one second with a two-tenth second in-



BENDIX SCL-3 SELECTIVE CALLING SYSTEM (GROUND EQUIPMENT)

terval between. The unit is designed for 19-inch rack mounting and can be remotely operated from a separate control box.

The Bendix receiving unit (airborne) is a dual-boxed aircraft receiver of familiar remote-mounting design, and flashes an indicator light at approximately 120 flashes per minute. When a combination of tones is received which is identical to the preset reed resonant frequencies in the receiver, selecting relays operate in sequence and actuate a lock-up relay which flashes the indicator light until the pilot answers the call.

The Motorola system (trade name "SELCAL") operates somewhat similarly and was developed in cooperation with Pan American Airways. Pan Am has been service testing "SELCAL" on its Pacific routes.

Each aircraft is equipped with a selective signalling decoder for each radio channel which must be monitored for an alerting signal. To call a specific plane, the dispatcher or other ground personnel selects a tone code and actuates the transmitter code generating unit. Upon receipt in the plane, this tone code activates a light or bell alerting the airborne crew. Only the selected aircraft is so alerted. Receiver alarms in other "Quik-Call"-equipped aircraft do not respond even though tuned to the same frequency. Non-equipped receivers monitoring the channel hear only an instantaneous tone pulse.

A total of over 1400 individual codes can be produced without duplication or without tone combinations conducive to false operation.

Motorola has two airborne units available mounted in a package of approximately 8 in. x 5 in. x 13 in. The two-channel decoder receiver TA-150 weighs slightly less than 13 lbs; the single-channel TA-151 weighs slightly less. Both are CAA-certificated.

Air-Aids Spotlight

BEDFORD, Mass.: *ILS shut down (for relocation) except for Outer Compass Locator available for ADF approaches.*

BLACKSTONE, Va.: *Northeast course of LF range swung to the East, bearing now 272° magnetic toward station.*

COVINGTON, Ky.: *ILS Outer Compass Locator now 287 kc.*

LANSING, Mich.: *LF range Initial Approach altitudes raised 600 feet to 2900 feet ASL on E and SE courses; also on VOR procedure transition from Romulus VOR.*

LOUISVILLE, Ky.: *GODMAN radio beacon on 323 kc southwest of Louisville on Red Airway 14 decommissioned.*

MEMPHIS, Tenn.: *ILS recommissioned on same frequency 109.9 mc, including LOM and LMM; voice and Glideslope shortly.*

MEXICO: *If planning cross-border flight, check World charts for following facility frequency changes:*

LF Ranges	
SAN LUIS POTOSI	354 kc
Radio Beacons	
ACAPULCO	292 kc*
GUADALAJARA	336 kc*
NAUTLA	392 kc
NUEVO LAREDO	321 kc*
TAMPICO	318 kc*
TEHUANTEPEC (now IXPEPEC "IZT")	365 kc*
TEQUESQUITENGO	323 kc
TULANCINGO	278 kc
TUXPAN	262 kc*

**(Note: All towers now guard 3023.5 kc)*

MINNEAPOLIS, Minn. *BVOR recommissioned on 115.4 mc in new location northwest of city; bearing 153°, 19 miles to airport across highest part of city.*

NEW YORK, N.Y.: *IDLEWILD New VOR commissioned as navigational and approach facility; voiced by tower but no weather broadcasts or routine flight plan service; 115.7 mc being tried as interim freq.*

New MEADOWBROOK intersection formed by back-course of TETERBORO ILS ("Teb" 108.1 mc) and northwest course LGA range on Red Airway 23.

WILLIAMSPORT, Pa.: *New Hughesville Fan Marker and Radio Beacon on east course of WILLIAMSPORT LF range six miles east. (FM ident. 1 dash; MHW frequency 266 kc)*

YOUNGSTOWN, O.: *New HUBBARD MHW facility on 408 kc "HRD", lines up on ILS course four miles beyond the Outer Comlo.*

"Look-See" For Airline Pilots Returns in New Reg

On the theory that it is always good to know how the "other-half" lives, *NAVICOM* feels that it will be instructive as well as interesting for non-airline professional crews to review the operational effects of the new air carrier regulation, CAR 40. This reg replaces both the old CAR 40 (AC Operating Certificates) and CAR 61 (Sched AC Rules).

In the over-all, the new regulation is more objective and drops a lot of unneeded detail. In effect, the air carriers are freed of much detailed red tape but charged with the discretion of their own operation. Some of the standards employed are excellent modernized indicators of good operating techniques for pilots flying similar equipment. For instance, *extended over-water operation* is defined as in excess of 50 miles from the nearest shore line, in determining need as to life rafts and other survival equipment.

Of similar interest is the regulation that a flight may be dispatched with a minimum of one L/MF and one VHF receiver provided the aircraft is fueled to proceed by either system in event of the failure of one.

Somewhat in line with the experience of professional corporation crews flying equivalent equipment is the easement of the route qualification requirements. In recognition of the value of modern IFR flight-simulators, airline crews need no longer qualify by execution of an instrument approach into each airport served, but may merely log one original take-off and landing and thereafter simulate the "entry" for qualification within the year concerned prior to actual landing.

Operation-wise, the two alternate airports requirement has been eased to where a pilot must select two only when the weather conditions forecast for the destination and first alternate are marginal, instead of basing this requirement solely on the destination airport being below limits at time of departure!

A decided revision in the general concept of IFR-plan flying is embodied in CAR 40.389 in that *no* alternate is required for IFR or over-the-top flight plan for air carriers when weather conditions at the destination airport are forecast to be "at least 1,000 feet above the minimum approach altitude. . . . and the visibility . . . . at least three miles for the period two hours before to two hours after the estimated time of arrival!"

So that there may be no misunderstanding, it should be clear that the minimums set forth above are basically a guide only and the intent of the regulation is strictly that there shall

e *no doubt* as to successful flight ermination at the destination! A non-ir-carrier pilot attempting to apply he above to his own flight planning hould give thought to the additional uel requirements that might be im-osed by ATC holding and full in-trument approach.

Of greatest significance in everday perations is the return of the old Look-See" privilege denied to air-arrier pilots for so long. After April , 1954 (and earlier in the case of ompanies obtaining a specific ap-roval in their operating certificates nd manuals) air-carrier pilots no onger will be prohibited from start-ng an instrument approach and let-own to minimums when weather at he airport in question is reported be-ow their minimums, *providing that* ither the approach is being made at n airport at which ILS and GCA are vailable and *both* are used for the pproach, or the instrument approach as progressed into its final phase at he time the below-minimum report s received, and in both instances the ilot has determined that conditions t least equal to the prescribed min-mums actually existed.

Three definitions here are subject o interpretation that may result in ndustry-wide discussion of interest to ir-carrier and non-air-carrier pilots like. First, what is meant by "both" LS and GCA are used? "GCA" is terally a *Ground Controlled* Ap-roach in which the pilot takes his eadings and descent instructions rom the controller rather than from cockpit instrument. Two kinds exist, AR (Precision Approach Radar) and SR (Airport Surveillance Radar), the atter having nothing like the accura-y of either the former or of ILS! Is he pilot to fly the ILS approach as e is accustomed, interpreting what e sees on his cross-pointer indicator nto corrective headings self-comput-d and listen to the controller "ad-ising" him as to how he is doing he common radar advisories in gen-ral use today)? This would seem to e the most sensible interpretation xcept for the love of some people to emand exact definitions when a "hot otato" is to be passed.

Or will some such individual in a ubsequent accident or violation hear-ng insist that the pilot should have aken "the full GCA" instructions and sed his ILS solely for monitoring urposes, as done by some crews?

And if the approach is being made n the back-course of the ILS where nly the less accurate ASR radar is vailable for monitoring, is the same egulation effective?

The fact that the approach no onger must be abandoned (ILS and

GCA not involved here) once the outer marker or associated LF or VHF range facility is passed (or on GCA final) if weather goes below minimums, is the only true return to the old days before the "No-Look-See" regulation was passed. This change returns to the pilot the descretion of completing approach and landing when, as so commonly happens, he finds at the point of breaking off descent that he has visual reference to the runway. No more infuriating decision ever plagued any pilot than that of electing to pull up and pass over an airport in the clear, go back on instruments and later explain to the passengers at some alternate a hundred miles away why he couldn't land them at their destination!

Undoubtedly, this change will result in many instances where considerable suspicion will arise as to whether a pilot had visual reference at legal minimums and didn't exceed his responsibility. The big item in such cases will be the existence today of *recordings* of the radar advisories associated with such approaches. Wherein it can be determined that the conduct of the approach beyond the point of apparent minimums indicates the probability of visual alignment with the runway, it is unlikely that any further doubt as to the legality of the landing will be raised. On the other hand, where the record indicates that the landing was completed only after the wildest gyrations between the middle marker and the boundary, there will be some grounds for doubt that the approach was completed legally!

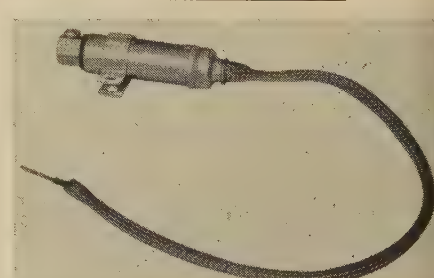
An interesting sidelight here is the obvious fact that the new regulation provides promise of handsome dividends on the ability to execute an excellent instrument approach. The happy coincidence is that an instrument approach so accurately executed deserves the benefit of lower minimums whereas many less accurate approaches should be arrested before they reach bottom! (Before any hue and cry is raised, it should be noted that many inaccurate approaches are the results of conditions outside of the pilot's control and no inference is intended that circuitous flight paths on final are the result of poor flying rather than flight conditions!)

The foregoing is of special interest to non-air-carrier pilots as an indicator of the thinking that is being applied to the general subject of better interpretation of weather minimums. Proposals to apply the "less than 75-mph stall speed" easement of visibility minimums to all aircraft when on straight-in approach are afoot. A curious item is the fact that a significant number of airline pilots plainly labeled the "glide path" as a facility of secondary importance when they voted that they would rather exclude this item in determining variable minimums based on parts of ILS system inoperative, as compared to the ILS VHF markers, the compass locators or the Hi-intensity lights!

Similarly, a significant majority reject the suggestion of substituting reference to painted runway markings in lieu of coded Hi-intensity runway lights, as a factor in determining other operational limitations for take-off and landing on instruments.

Non-airline pilots not enjoying the representation of their brothers on the councils that determine these things, it behooves them to study the proposals and regulations anent the operations of the airlines and apply the lessons to be learned to their own advantage.

Whereas the airlines enjoy "sliding scales" operative over their whole systems, non-airline pilots plagued by unrealistic visibility minimums must use their ingenuity to accomplish completion of their missions. If a technicality prevents a pilot on full IFR plan from completing an approach to a landing in low visibility under conditions where a VFR flight could legally obtain a clearance "ground contact", conversion of the flight classification *after* the ATC clearance for approach has been given is but fighting fire with fire. In view of the fact that many corporation aircraft and crews operate with equipment and standards comparable to the airlines, it should only be a matter of time until the CAB promulgates a set of regulations as modern as the new CAR 40 for other than airline operations.



New Ignition Noise Filter

LearCal Division of Lear, Inc., has brought out a new ignition noise filter identified as MF-1. The MF-1 is easy to install with almost all popular makes of engines using magneto ignition. It prevents ignition noise from being conducted through the mag line to the On-Off switch and being radiated from there to radio receivers, particularly VHF.

Executive Transport

(Continued from Page 11)

no airliner meets all the requirements is to performance. While the latest our-engine airline equipment can neet all the other performance speciications, none can approach the imortant requirement for short-field operations. Second, while Corporate Management is quite willing to pay heavily for acquisition and operation of airplanes most nearly meeting their requirements, these costs are still primary considerations. Even if a DC-6 had adequate short-field perormance, a corporation transporting an average of 10 persons in a $150,-000 DC-3 at 200 mph could scarcely be expected to spend 10 times $150,-000 for a DC-6 (to say nothing of the manifold increase in hourly operating costs) to haul the same people 100 mph faster and over somewhat longer non-stop stages. Finally, even if the DC-6 had the performance and even if the corporation were willing to stand the costs, the purchase and operation of such an airplane for the transportation of a few executives could scarcely be justified to stockholders, customers and, perhaps, the Bureau of Internal Revenue. Only such a firm as Arabian-American Oil Co., operating, in effect, a captive transoceanic airline with constant high load factors, can justify use of modern four-engine airline equipment. And modern two-engine airliners do not offer either the speed or the range desired by Corporate Management.

What then does Corporate Management do for executive airplanes? It compromises. Some Corporations have sacrificed speed for comfort and utilize DC-3's or, for a little more speed, *Lodestars.* Some sacrifice comfort for speed and operate converted B-25's, and B-26's. Some try for the middle road in speed, comfort and operating economy with PV-1's and B-23's.

We at Lear, Inc., have our own program dealing with this problem. From the time we acquired our first *Lodestar,* I repeatedly found myself eyeing her trim lines and wondering why something with such a beautiful body didn't get around faster. We finally concluded that all this girl needed to move right with the vanguard of the really fast crowd was some good plastic surgery, and it was decided to attempt to provide it. Two years ago we began the job, since taken over by the Aircraft Service Division of Lear, Inc.

Without attempting to enumerate all the various operations, major and minor, we have performed and are performing on the *Lodestar,* I shall say only that we have cleaned it up enough that our experimental prototype is cruising above 270 mph at altitude, with several major speed modifications yet to be applied. I recently flew this airplane at normal cruise power from Chicago to Los Angeles, staying four minutes ahead of a scheduled DC-6 all the way.

When we have completed our present *Lodestar* modification program and have produced the first of what we have dubbed the *Learstars,* we shall have an airplane which offers speed to match the fastest airline schedules, better than airline accommodations for up to 10 persons (including pressurization for those who wish to pay the tab), transcontinental or transoceanic cruising range, the excellent short-field performance which is characteristic of the *Lodestar,* relatively low initial cost and extremely low comparative operating costs.

However, even if the *Learstar* is the success we believe it will be, there are only a limited number of basic *Lodestars* available for conversion. In any case, transporta-

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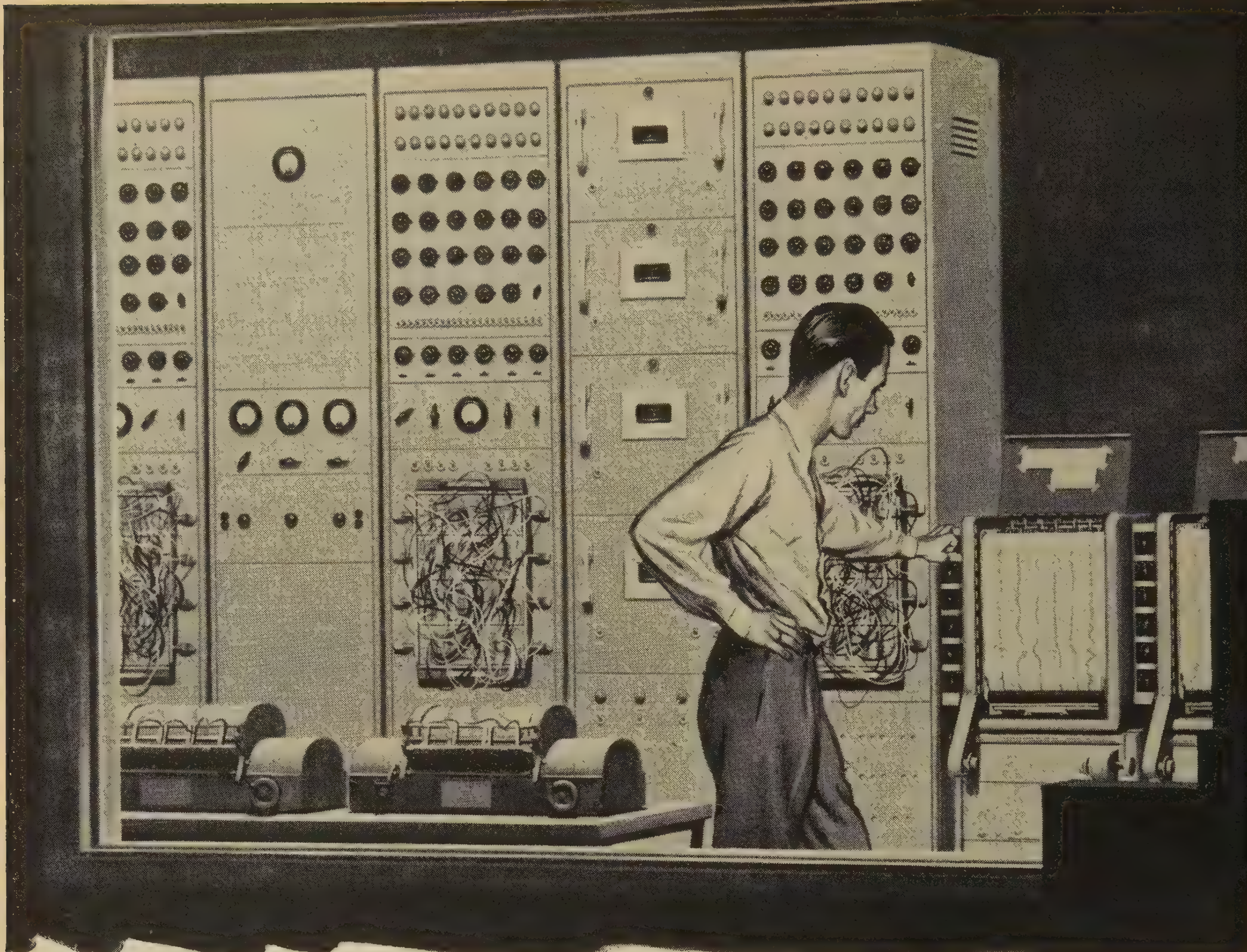


INVISIBLE JET FIGHTER MAKES TEST FLIGHT

This Grumman jet fighter is invisible. She is electrons. Yet day after day, she makes supersonic flights through an electronic sky.

Actually she is an electronic brain by name of REAC (Reeves Electronic Analog Computer) directed by a group of brilliant human brains. The latter convert the mathematics of the aircraft into a language they and she understand. They "tell" her everything they know about the new fighter design through wired panels and curves wired on revolving drums.

The cockpit with its human pilot is plugged in. At a signal he takes off and climbs to fifty thousand feet. The electronic air is smooth up to the transonic range where sound waves pile up until the air misbehaves. Once through, the air is smooth again, and they are ready to test a combat maneuver at supersonic speed.

"Now decelerate."

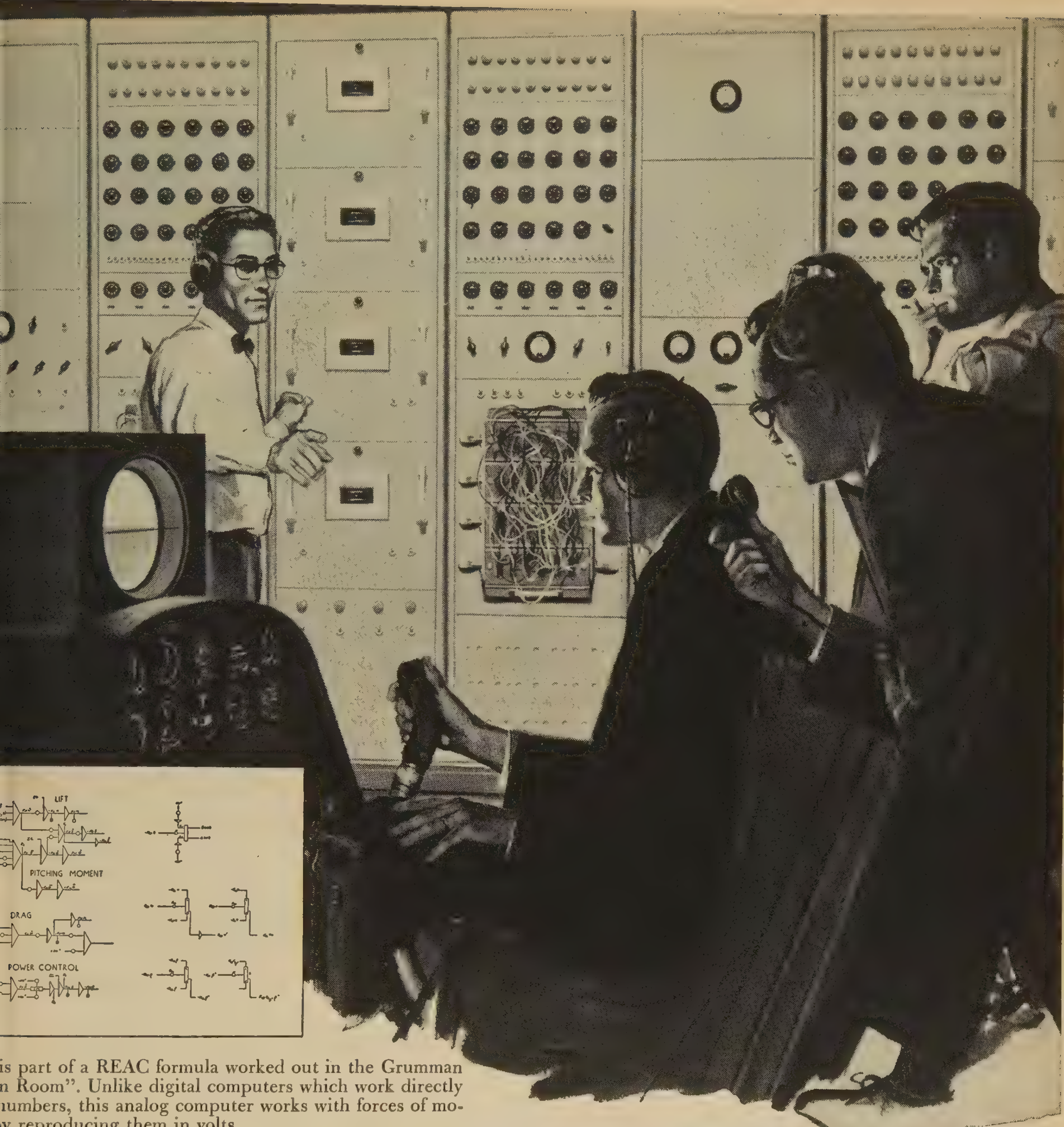
The pilot extends speed brakes. All eyes watch the instruments, and the reactions recorded on moving graph paper.

These performance data, gained months before actual flight tests, help check designs created with results from other Grumman research. One reason Grumman planes are ready in quantity when needed.

Grumman

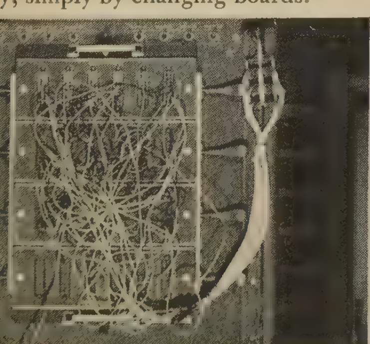
GRUMMAN AIRCRAFT ENGINEERING CORPORATION • BETHPAGE • LONG ISLAND • NEW YORK

Designers and builders of the Cougar jet fighter, the S2F-1 sub-killer the Albatross amphibian, metal boats, and Aerobilt truck bodies.

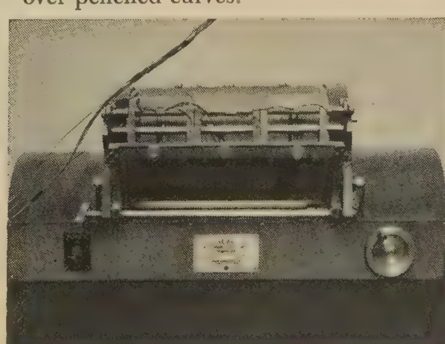


is part of a REAC formula worked out in the Grumman
n Room". Unlike digital computers which work directly
numbers, this analog computer works with forces of mo-
y reproducing them in volts.

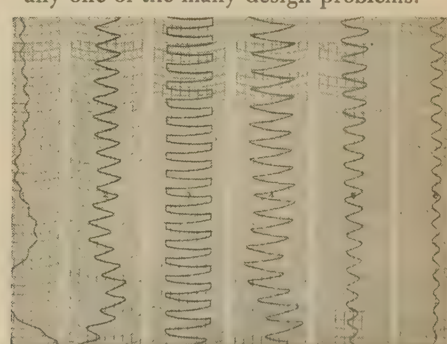
omputer is "told" the facts of
roblem through miniature
boards. A different problem
made known to the computer
y, simply by changing boards.



Some data, like wind tunnel results, are fed into the computer from revolving drums. The computer gets its information electrically from copper wires glued over penciled curves.



These are typical REAC answers. Engineers translate these squiggles into design information. Sometimes thousands of such answers may be required to solve any one of the many design problems.



Executive Transport

(Continued from Page 33)

tion progress continues and we can clearly foresee that the demands which Corporate Management Transportation, like the other classes of executive aviation, makes of its equipment can only increase as time and progress go on.

Airplane manufacturers will have to produce new Corporate Management Transports within the near future. The market has become too large to be denied.

The prime factor which will determine the general specifications of a new Corporate Management airplane is to be found in the full definition of the word "best" as used in saying that Corporate Management requires the very best in the way of executive airplanes. Executives at the Corporation Management level are in general basically conservative. To them the word "best" implies "*proven* best". Therefore, it follows that an airplane will be acceptable to them only if it is designed and constructed on the basis of proven principles and incorporates proven major components. The airplanes they now use are known quantities as to safety of operation, performance and costs. Corporate Management will buy improved versions of these known quantities but, generally speaking, will not buy radically new airframe design concepts powered by new types of engines.

In addition, although the Corporate Management Transportation market has a vast potential, it probably could not, in the immediate future, absorb the tremendous cost of developing a new turboprop or pure-jet transport. In any case, the aircraft manufacturers cannot be criticized for not launching into such development on speculation, at least not as long as they have military and airline customers whose advance commitments for large fleets cover the development costs of the airplanes.

The completion of development and field-proving of any satisfactory turboprop or jet transport for either airlines or military appears to be still some years away. Even when such a transport has been readied, it will in all probability fail to meet some of the executive users' requirements, because it will have been designed to do a different job. And, even if it should be quite satisfactory for executive use, it would undoubtedly be some time before military and/or airline priority orders were filled and production available for supplying the executive market.

Thus, it is evident that any Corporate Management transport airplane produced within the relatively near future will *have* to be a high-performance piston-engine airplane of fairly conventional design.

The right combination of the most improved versions of the standard features of modern piston-engine transport airplanes can produce an executive airplane which, because it need not accommodate the huge payloads of an airliner, will out-perform any piston-engine airliner in every category from high cruising speed to short landing roll. I anticipate that such an airplane, the first to be designed and built specifically for modern top-level executive transportation, will be flying within two years.

When this modern executive transport appears, it will have, by virtue of utilizing the modern approach to aerodynamics through boundary layer considerations, an outstanding performance. To illustrate the potential of this approach, a design study of four executive airplanes has been prepared based on a 10-place executive airplane having a range of 2700 miles at a speed at least as good or better than present airlines.

The results of this study are shown in *Figure X (page 9)* and *Table I.* Four designs A, B, C, and D were chosen displaying currently available attainment in performance on the one extreme, Designs A and B, to the full boundary layer controlled airplane for the futuristic extreme, Design D. The latter is based on re-

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TABLE I

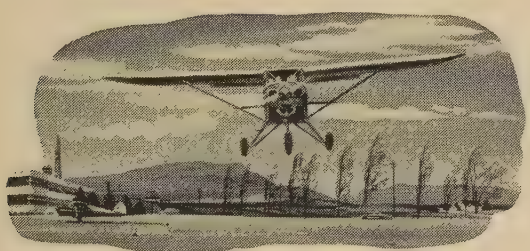
All Versions Have 2700 Mi. Range at 20,000′ with 2400# Payload (W/S)cr = 60#/sq.ft.

Design	A	B	C	D
Wing Area	164 sq. ft.	244 sq. ft.	148 sq.ft.	103 sq.ft.
Wing Span	40.5 ft.	49.5 ft.	38.6 ft.	32.2 ft.
Aspect Ratio	10	10	10	10
Thickness Ratio	10%	10%	10%	10%
Fuselage Length	50 ft.	50 ft.	50 ft.	50 ft.
Fuselage Diameter	7 ft.	7 ft.	7 ft.	7 ft.
Total Wetted Area	1388	1603	1356	1266
T.O. E.S.H.P.	1500	3000	1500	750
Gr. Wt.	12,100#	18,300#	10,550#	7000#
$(W/HP)_{T.O.}$	8.06#/HP	6.10#/HP	7.04	9.34
$(W/b)^2_{T.O.}$	89,100#²/ft.²	136,500#²/ft.²	74,800#²/ft.²	47,400#²/ft.²
$(W/b)^2_{cruise}$	59,500#²/ft.²	87,500#²/ft.²	52,600#²/ft.²	36,500#²/ft.²
$(W/S)_{T.O.}$	74#/sq.ft.	77.7#/sq.ft.	71.3#/sq.ft	68#/sq.ft.
$(W/S)_{cr.}$	60#/sq.ft.	60#/sq.ft.	60#/sq.ft.	60#/sq.ft.
$(W/S)_{lnd.}$	46#/sq.ft.	46.5#/sq.ft.	48.4#/sq.ft.	51.5#/sq.ft.
$C_{L_{max}}$	2.0	2.0	3.0	4.0
e	0.9	0.9	0.9	0.9
f	3.76 sq.ft.	4.56 sq.ft.	1.461	0.470
C_{D_o}	.023	.0187	.0099	.0046
$C_{F_{eff.}}$	.00271	.00285	.00108	.000372
$V_{cr.}$	370 m.p.h.	455 m.p.h.	500 m.p.h.	500 m.p.h. on 68% HP_{cr}
$V_{T.O.}$	120 m.p.h.	123 m.p.h.	96.5 m.p.h.	81.5 m.p.h.
$V_{lnd.}$	95 m.p.h.	95.5 m.p.h.	79.5 m.p.h.	71.0 m.p.h.
$R/C_{sl.T.O.WT.}$	2774 FPM	3972 FPM	3523 FPM	2690 FPM
R/C 20,000 cr.wt.	1335 FPM	2252 FPM	1915 FPM	1367 FPM
Time to 20,000′ t.o.wt.	14.3 min.	8.7 min.	9.8 min.	12.6 min.
Service Ceiling—full HP	37,500′	42,000′	42,500′	40,700′
Service Ceiling—half HP	20,000′	30,000′	30,000′	28,000′
T.O. over 50′	3000	2400	1680	1600
LND over 50′	3120	3150	2300	1920

5 fine features 5 right reasons WHY YOU'LL PICK PIPER

1 PERFORMANCE for real utility is yours in the Piper Tri-Pacer. Over 120 mph cruise, over 575 mile range with ample climb that lets you enjoy the smoothness of flight at altitude. Remarkable short field ability, too. Powered by the economical, superbly reliable 135 hp Lycoming engine.

2 COMFORT You fly quietly and comfortably in the Tri-Pacer—with plenty of room for four people and baggage. Generous sound-proofing plus tastefully upholstered foam rubber seats mean restful, relaxed travel. Separate front, rear and baggage doors are exclusive Piper conveniences.



3 LANDING EASE Like every modern airliner and jet, the Tri-Pacer has tricycle landing gear. You land almost automatically with little concern about cross-winds. Steerable nose wheel simplifies taxiing, single hand brake brings you to a rapid stop. Level attitude gives better visibility and taxiing ease in high winds.

4 FLYING EASE You'll like the simplified controls which interconnect rudder and ailerons so you fly with either wheel or rudder pedals as you wish. The Tri-Pacer's stability is remarkable with highly stall-resistant characteristics which will impress you. Compact design means smooth flight in rough air, too.

5 ECONOMY The Tri-Pacer is nearly $2,000 less than any other 4-place plane in volume production. Its operating costs are correspondingly lower with better than 15 miles per gallon. Rugged bridge-type steel and aluminum construction with Duraclad covering means long-lasting durability.

PLUS THE BEST REASON OF ALL—

PIPER DEPENDABILITY . . .

the result of building more farm, business and personal airplanes than any other manufacturer in the world. Learn more about the Tri-Pacer. *See it, fly it* at your Piper dealer's or write today for full-color brochure. Dept. 5-K.

PIPER

AIRCRAFT CORPORATION
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Executive Transport

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sults which appear in the research phase to be attainable.

It can be clearly seen from *Figure X* that with only 1500 hp an airplane following Design A could cruise at 370 mph using a turbopropeller rated at 1500 hp for take-off. With a piston engine following the more classical theme of a tried and proven powerplant, this design would involve a somewhat higher engine weight, but because of its lower fuel consumption the gross weight at take-off would be somewhat reduced, although the gross weight on landing would be about 5% greater. Nevertheless, the performance of such an airplane would even two years from now be considered phenomenal. The quality of the external aerodynamics of this airplane is similar to that of the de Haviland *Comet.* Even so, the skin friction of this airplane is equivalent to that of a totally turbulent flat plate. Clearly there exists considerable opportunity for improvement of its performance.

The second airplane in *Figure X,* Design B, possesses the same quality of aerodynamics as Design A but is fitted with higher power engines so that a cruising speed of 455 mph is realized. Here again the use of a turboprop is contemplated. But what is most vividly displayed in the comparison of Designs A and B is the extreme cost in weight and fuel in an attempt to gain an additional 85 mph in cruising speed by the extravagance of power. Three thousand pounds of additional fuel must be burned to move 10 people 2700 miles. Fifteen hundred more horses must be maintained and the gross weight at take-off is three tons more for Design B.

Now for the era following the classical executive airplane, there is considerably more to offer. The research currently in progress offers two contributions to external aerodynamics which portend large gains in performance. By using boundary layer control the stall of a wing can be delayed to lift coefficients about twice what is currently being attained with flaps. And, most important for small-field operation, this high lift is attained with comparatively low profile drag. The second gain to be had from boundary layer control is a low drag through the retention of a laminar boundary layer over a large part of the wetted area of the plane.

In *Figure X* the airplane of Design C is fitted with boundary layer control both for high lift and for low drag. This airplane cruises at 500 mph yet can take-off over a 50-foot obstacle in 1680 feet using a 1500-hp turbopropeller. The extent of laminar flow covers only 60% of the fuselage and 75% of the wing.

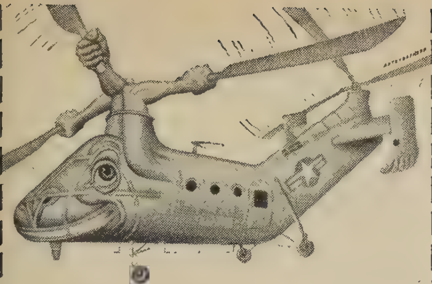
Finally, Design D on *Figure X* is the ultimate in performance and utility. With a turbopropeller of 750 hp take-off rating, this little airplane carries 10 people at a speed of 500 mph on 260 hp yet gets over a 50-foot obstacle in 1600 feet. The airplane weighs only 7,000 pounds yet has a range of 2700 miles. This airplane is, of course, the acme of aerodynamic perfection having a very smooth exterior, and boundary layer controlled so that the complete wetted area enjoys the low drag of a laminar boundary layer.

How soon can we expect the benefits of the new developments in engines, propulsion systems and boundary layer control to be realized in an executive airplane? The naked truth is that such an airplane as Design D must inevitably come as an evolutionary development. However, there is no need to wait for low-drag boundary layer control when high lift can be accomplished today with suction boundary layer control. So it is with the shrouded propeller which yields about twice the static thrust of a propeller of same diameter. The turboprops are already in the tried and proven category on the English *Viscount* transport.

Upon examining the Designs A, B, C, and D in *Figure X,* we arrive at the stark conclusion that aerodynamic improvements now in the laboratories will yield a smaller, lighter, faster, more economical and safer executive airplane. This airplane, illustrated in two configurations in *Figures Y* and *Z,* offers the next best solution to the process of duplication of executives mentioned in the introduction to this article.

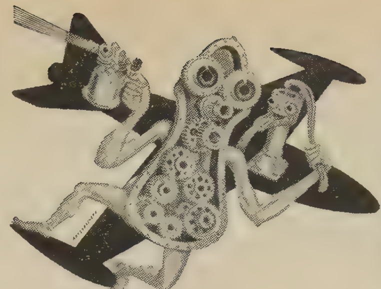
In closing, I wish to point out that Lear, Inc., does not contemplate any such airplane. Our primary interest is stimulated by the fact that it takes longer to develop precision components for airplanes than to develop the airframes themselves. Our aim is to keep abreast of the latest concepts of airplane design so as to anticipate airframe and engine manufacturers' future needs for the types of components produced by Lear, Inc.—namely automatic control and stabilization systems, actuators, gyro instruments, pumps, radio and other electronic and electro-mechanical devices.

Presented at the SAE Annual Meeting held in Detroit, Mich.



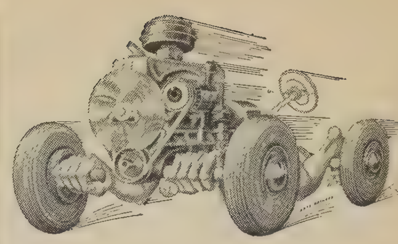
How a helicopter hangs by its "elbows"

For flexible "elbows"—625-part rotor assemblies that control the amazing maneuvers of its dependable H-21 "Work Horse" Helicopter—PIASECKI *looks to Lycoming!*



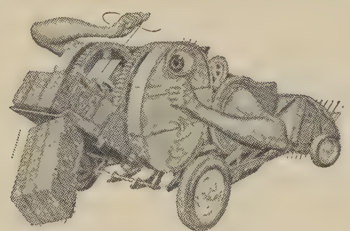
How a jet engine runs on its "nerves"

To produce the auxiliary "nerve center" for its J-40 jet engine—a complex gearbox that transmits power to vital engine accessories—WESTINGHOUSE *looks to Lycoming!*



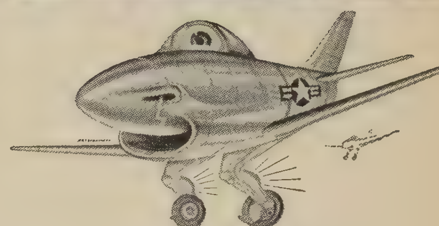
"Sinews" to give cars "go"

For vital automotive parts—mass-produced precision components that can "take it" year after year—leading automobile manufacturers like FORD *look to Lycoming!*



Strong "wrists" for America's new hay balers

For sturdy, dependable spur and bevel gears—"wrists" that drive the tying mechanism of its "one-man" time- and money-saving hay baler—NEW IDEA *looks to Lycoming!*



"Leg muscles" that cushion a jet's landing

For tough main leg cylinders that house the hydraulic action which enables the F-86 Sabrejet to absorb fast landing jolts—CLEVELAND PNEUMATIC *looks to Lycoming!*

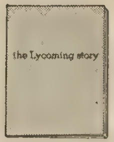
Small parts that play a "big part"

Peak performance by any product requires big performance from small parts. Lycoming's skill at producing such custom parts explains why so many leading manufacturers look to Lycoming.

Look at Lycoming's record! Parts ranging from tiny precision-made aircraft gears to rugged mass-produced automotive parts. And scores of others produced for America's industrial and military leaders. All "living" evidence that Lycoming can solve *your* metal-working problem, too!

Aircraft executives please note.

If you need dependable parts . . . or any other diversified services listed with our signature . . . call us without obligation. Lycoming's wealth of creative engineering ability, its 2½ million square feet of floor space, and 6,000-plus machine tools stand ready to serve you. *Whatever* your problem . . . *look to Lycoming!*



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Long-term contracts with U.S. Air Force for gas-turbine power plants provide unlimited opportunities for top-flight engineers. Write Project Coordinator outlining experience in detail. Lycoming Division. Avco Mfg. Corp., Stratford, Connecticut.

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DIVISION OF AVCO STRATFORD, CONN.
Manufacturing plants in Stratford, Conn. and Williamsport, Pa.

Skyways Round Table

(Continued from Page 19)

industry considers it feasible to have a common structure for antennas of competitive television broadcasters."

Jay W. Wright *(Chief, Radio Engineers, Columbia Broadcasting System, Inc.)*: "In general the idea of a common transmitting location has its advantages to telecasters as well as to the aeronautical interests, and wherever possible we try to move in that direction. Here in New York we have the Empire State Building with its common antenna installation and in Los Angeles we have Mt. Wilson with its antenna farm. Of course, this common location idea is not always possible, but we are in agreement that there are certain advantages in it. Each case, however, has to be treated on its own merits."

J. Lederer: *"Mr. Burton, have you anything further on this location of towers in the right-of-way of aircraft?"*

L. W. Burton: "Certainly, it isn't to the advantage of either the broadcaster or the aircraft operator to have a tower located on a heavily traveled air route or in the airspace where the hazard of collision is far greater than it would be someplace else. If an airplane hits a tower, the chances of heavy loss of life are very apparent. Also, such a mishap would demolish the structure, which would prove costly to the broadcast people, to say nothing of the fact that if it were a common tower, you'd have knocked out all TV service to the public in the entire community or metropolitan area for some period of time. It's obvious that the broadcasters and aeronautical people would do well to get together on this question."

J. Lederer: *"Mr. Wright, what would the economical loss be if a tower were knocked down?"*

Jay W. Wright "More important to us is the loss of life and other effects. We have a very great stake in this that is measured in bigger values than dollars, and it is important to us as well as to the aeronautical industry that we coordinate our thinking and cooperate to get the best possible solution.

"As to actual dollar value, I'd say that a thousand-foot self-supported tower would cost somewhere on the order of half a million dollars. A guyed tower generally costs less.

"The loss in airtime may be more important than the loss in capital value of the tower. According to our rate cards, the airtime in large cities runs $2,000 to $5,000 per hour."

Robert E. L. Kennedy *(Kear & Kennedy)*: "If I may, I'd like to go back to the letter from AOPA. As far as the conditions at the Reading Airport when the crash occured are concerned, the official investigation by CAB will show that the ceiling was 200 feet at the point at which the aircraft hit the guy wire of the tower. I think it will also show that visibility was half a mile and not 10 miles as that letter stated.

"I'd also like to point out that the idea of putting marker balls on guy wires was turned down by the CAA as well as the television industry. The objections were based on technical reasons. As I recall, the suggestion put forth by the FCC called for balls about a foot in diameter. The diameter had to be small because of the wind loading. Computations showed that a ball one foot in diameter against a perfectly contrasting background is visible only at about 3300 feet under ideal conditions.

"On the subject of marking the guy wires, one of the sub-committees of the Air Coordinating Committee is now in the process of establishing a special committee to investigate and to make recommendations on the adequacy of present marking and lighting of tall structures, particularly those supported by guy wires."

J. Lederer: *"When you said it was difficult to see at 3300 feet, is that one ball or a series of balls?"*

R. E. L. Kennedy: "That computation was based on the ability of the eye to resolve an object. At 3300 feet we would presume that the ball was of some color which would definitely contrast with its background. That is hard to do under all conditions of lighting—smoke conditions, etc. We can't get an ideal contrast."

J. Lederer: *"Perhaps we're striving for perfection whereas something less than perfection might be a big help in the meantime. I have seen these balls around Orly Airport in France and also in Switzerland, and they were very visible. Perhaps one ball would be difficult to see, but when you have them strung in series, perhaps 100 feet apart, I would think they would be visible at quite a distance."*

H. P. Henning: "What about having an aluminum or metal ball in the vicinity of the antenna that would act as a reflector of radio waves?"

R. E. L. Kennedy: "Other than visibility, the only objections were mechanical—the additional wind-loading they impose on the tower.

"As far as the Bureau of Standards can determine, there is no satisfactory way of marking the guy wires themselves. But they have done some work toward use of a flashing light of very high candlepower either at the base of the guy wires or at the base of the tower or someplace where it would be unobstructed. This location was chosen because the Bureau people felt that pilots flying under marginal conditions would most likely be looking at the ground and not up in the air."

H. P. Henning: "What about floating a good-sized balloon at each anchor point? That would increase the mass of the general area."

R. E. L. Kennedy: "Then what do you do when you have a tower 1,000 or 1500 feet high and your ceiling at the moment is 500 feet . . . where do you fly the balloon?"

H. P. Henning: "On the basis of increasing the mass at the point you want to make visual, you'd tie the balloon at a relatively low altitude, perhaps 100 feet or so. It would act as an attention-getter to a location."

J. Lederer: *"Your thinking now of VFR only?"*

H. P. Henning: "Yes."

L. W. Burton: "In the operation of present-day aircraft, a lot of navigation work is done by radio and electronic aviation aids. It is too often possible that the pilot might not be as alert as he should be. Therefore, the idea was brought up about having an electronic marker of some sort which could give a flashing red light in the cockpit or an aural indication of proximity. I was wondering if the TV industry itself, being an electronics industry, had given any thought to marking towers in that manner."

R. E. L. Kennedy: "During the deliberations of the Tall Tower Committee which drew up the present criteria for tall towers off of airways, that marker suggestion was made. Electronic aids of that type are not only possible but practical. However, the Armed Forces objected to it on the basis that in air navigation the tendency of the pilot was to fly toward a beacon. Capt. Armstrong of the Navy pointed out, for example, that in flying your LF ranges you fly toward the transmitter, or away from it, whichever course you happen to be on. Most of your navigational aids are in the nature of homing aids, and the Military felt that such a beacon might become an attraction rather than a warning."

H. P. Henning: "It's been a common practice of pilots in the past who were flying aircraft equipped with ADF, to avoid radio structures by tuning to them and having their needle point to that structure."

M. E. Phillips: "It's my understanding that the record of accidents in connection with towers will bear out the fact that a very high percent-

age occurred when the aircraft was being flown VFR or when the pilot was changing over from IFR flight to VFR. The discussions always have indicated that under such circumstances there is a very strong likelihood that such markings would not provide the desired protection. In addition, it would be necessary for aircraft to be equipped to receive the required frequency and, in the case of some light aircraft, they don't carry radio at all. Therefore, to protect all aircraft, we would have to be assured that the aircraft would be adequately equipped with airborne radio and that they would stay tuned to the correct frequency. To successfully employ the marker-type system, there are many requirements necessary before you can obtâin safety with such a device, and discussions indicate it is unlikely that all these requirements could be met."

J. Lederer: *"I might add for the record that this device was used in England during the war to keep fighter pilots from hitting barrage balloons and the wires that held the balloons, so there is precedent for it."*

M. E. Phillips: "It *can* be accomplished. But under those circumstances in England, it was possible to issue instructions to the pilots as to how they would fly and what type of equipment they carried."

J. Lederer: *"There are several devices along this line under development. Lear, Inc. is interested in developing a device which would impose a squeal on top of your radio signals when you are approaching an obstruction to navigation. United Air Lines is financing the development of a device which is said to weigh not more than 7 pounds and cost $50. It is primarily intended to reduce the chances of mid-air collisions, but is could also be applied to marking obstructions. This is under development in England and there probably will be nothing available for another year or two. The basis of it is a small radio built for air-sea rescue purposes by the Ultra Electric Company of England. Simmonds Aerocessories Co. in this country has rights to it."*

R. E. L. Kennedy: "I'm not acquainted with the device, but it sounds something like the idea of a proximity fuse."

J. Lederer: *"That's still another idea that's been thought of for mid-air collision warning, but the range is so small that it wouldn't be practical for marking towers."*

M. E. Phillips: "As you probably know, here in Region 1 we have recommended and have installed obstruction markers that we call H-A-Z

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markers on very high towers. They are letters 30 feet high and are installed on the ground at the extreme point of the anchoring of the guy wires, and they spell out H-A-Z."

J. Lederer: *"The use of such letters would help under VFR conditions. I presume the aural marker would be for IFR."*

William P. Person *(Managing Dir., Air Transportation, Flight Safety Foundation):* "I don't mean to discourage the development of any aural signals, as I feel that some type of automatic indication is what we will have to come to. It would seem to me, however, that one of the most logical and the quickest approaches to this problem would be to get into this lighting situation. As it stands now, these towers are lighted. They all have prescribed locations for lights, and I think the best solution would be to use these discharge lights at the present locations.

"Somebody in the industry should take the lead on this lighting of towers with either high-intensity flashing lights or a discharge light. They are not too expensive to run and they attract your attention and can be seen in the daylight or during periods of restricted visibility."

R. M. Woodham *(Admin., Cornell-Guggenheim Aviation Safety Center):* "For your general information, these condenser discharge lights, the type used in high-intensity lighting, are manufactured by Sylvania, Westinghouse, General Electric and others. It is essentially the Krypton bulb which has a candlepower of some 10 million, or 10 times the intensity of the sun. The flash of that light is so short that it does not affect the pilot's dark adaptation, and it can be used either day or night. It's my understanding from pilots flying into Newark that under ordinary conditions with some overcast, they can see the lights from a distance of 50 miles. The lights make a definite pattern on the clouds and actually lead the pilots into the airport. These are the same type of lights that are used in London and which everybody considers to be more or less an ideal type of lighting."

A. P. Walker *(Mgr. of Engr., National Association of Radio and Television Broadcasters):* "This particular type or idea of a flashing light already has been tried out at one of the stations in the southwest, WFAA in Dallas. My recollection was that during daytime under bright sunshine conditions the lighting was most unsatisfactory."

W. P. Person: "Well, if it's a bright sunlit day, you don't have this critical problem anyway."

J. Lederer: *"Here again, gentlemen, I'd like to bring up this matter of perfection. We should not try to get a perfect solution right away. If it's 80% or 90% satisfactory, it might be well worth considering.*

"Mr. Kennedy, would you discuss the idea of using multiple short antennas by using slave stations and TV boosters?"

R. E. L. Kennedy: "It just isn't practical with our present system of television. During the period the so-called television freeze existed, a proposal of that nature was made. They called it polycasting. Had it been adopted, it would have obsoleted every single television receiver in the United States. To the best of my knowledge, it was the only system which could have been used to some advantage there, but in the system in use today, it's not practical."

Tom Sullivan *(Chief, Aviation Planning, Port of N. Y. Authority):* "The Port Authority's interest is the promotion of air commerce into the port district, consistent with safety

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and with the most expeditious and efficient handling of that air traffic into our airports. A tower located in the wrong place will affect the movement of traffic into the airport. To illustrate: Assume an aircraft descends at 500 fpm and you have a new tower located so that the initial approach altitude is increased by 500 feet, then you actually are delaying each airplane into the airport by one minute. If there is a backup of traffic, 10 airplanes could have a total delay of somewhere between 50 minutes and an hour. Such delays could conceivably cause the diversion of traffic to alternate airports. That is not the way to promote air commerce.

"We subscribe to this common area theory, that is, having all the TV transmitters located at one spot, like the Empire State Building here in New York, where it will not affect enroute traffic. We have just begun a study which already indicates that we must not only think of present-day fixed-wing traffic, but we must start thinking in terms of helicopter traffic, which comes in underneath the established altitude for fixed-wing aircraft. If and when the WOR tower is removed, we will be able to open up an excellent lane for helicopter traffic going to and from the airports as well as to various points north, south and west.

"Therefore, in addition to the common problem of locating towers, marking them, and NOTAMs regarding them, it is becoming apparent that we must all be cognizant of the helicopter traffic as well as fixed wing."

Howard Higgins *(Chief Pilot, N. Y. Airways):* I regret to say that in my experience I have not seen these H-A-Z markings Mr. Phillips mentioned. A distinctive marking on the ground itself, under VFR conditions, would be a lot better than floating balloons. If the ground itself or the buildings that cover that area were distinctively marked, you could see it a lot quicker than you would anything else. I've found that distinctive patterns on the ground are much more apparent than something 100 feet or 200 feet in the air, because you are making reference to the ground all the time. This, of course, is under VFR conditions.

"Getting into instrument conditions, it's going to be pretty hard to impose the need for additional equipment in order to find all these various towers, etc., that are put up in the air. Lights on the towers would be a big help in VFR at night, and would take the place of the markings on the ground. In the daytime under haze conditions of 1/2 mile or a mile visibility, lights are not much good unless they are terrifically brilliant.

"As Mr. Sullivan brought out, we try to separate the fixed-wing traffic and the helicopter traffic. And, as Mr. Henning said, you always have to jack up the minimum altitudes when such obstructions as TV towers and tall towers are erected. Now there's a limit to how high you can go with enroute altitudes. We'd like to move underneath the long-haul carriers because we're not going as far. But if we do that and we are restricted to minimum enroute altitudes up to 3,000 or 4,000 feet, we're certainly going to take a beating.

"Now just one thought on these air markers. It's going to be hard to force everybody to have all these aids and to also monitor them inasmuch as we're all trying to accomplish this with a minimum of equipment and personnel. It'd be fine if you could put another person in the cockpit just to watch all these warning devices and to pour over your maps so you'd know where you are every minute, but if you do that, you're getting back to the payload problem—you can't take anything with you so there's no use going.

"And the same is true with regard to notifications. You have to have another man sitting at a desk looking out for the NOTAMs and keeping them up-to-date. You'd have to have a three-hour briefing with the pilot just to tell him what to look out for.

"Personally, I feel that this idea of grouping the towers is one solution to the problem. For our operation more so than itinerants, if all the towers were in a general location, we could set up our operation so that we would skirt the area. Certainly, the TV antennas that are presently set up or that possibly will be set up are going to be an obstruction to a helicopter operator when he starts operating on instruments."

Dick Dinning *(Operations Specialist, ATA):* "Perhaps it would be pertinent to point up the historical perspective of this problem. In terms of the relatively short life span of the television and aviation industries, this is not a new problem. Some sort of aeronautical review has been given to radio towers since aviation became of age. However, until 1949 it was not a well organized review and, with the prospect of television, the need for a better organized system of aeronautical review was very apparent. In 1948 and '49 steps were taken to meet that need. This was not a unilateral approach; it was conducted by both the aeronautical and the radio-television interests. Basic criteria, basic ground rules were discussed and established.

"It's important to recognize that the ground rules, the criteria we have today, are only the starting point for consideration of the aeronautical problems involved. Aeronautical procedures are so complex no criterion could include them all. Furthermore, the procedures in aeronautics are constantly changing with the use of radio, new terminal procedures, the use of new equipment, helicopters, etc., all of which involve new problems and new requirements. Therefore, it's important to have such a forum as the Airspace Sub-Committee available to consider the problem of tower obstructions, and to have procedures for these considerations flexible enough to take care of the changing requirements.

"In 1952 when the FCC issued its frequency allocation order and when proposals for very high TV antennas began coming in, it was recognized by both aeronautical and TV interests that unforeseen problems were being encountered and that a joint review of the subject would be helpful. Therefore the 'Tall TV Tower Committee' was established and on it were representatives of the CAA, the FCC and aeronautical interests.

"The interest in resolving the problems that are still with us and the problems that are developing is a joint television-aviation interest. Even now joint consideration is being given in the ACC to the problem of better marking and lighting of very tall structures."

L. G. Cumming *(Tech. Secy., Institute of Radio Engineers):* I'd like to thank both aviation and the electronics group for their cooperative action. I'd like also to second Capt. Higgins' plea for the low-altitude flyer. As a matter of fact, if we stick to electronics and start using those gadgets as aural-warning devices, we'll end up with a radar beacon or some form of reflector on top of everything that's 400 feet or taller. When that happens, the radarscope will look like a kaleidoscope and the pilots will be even further confused.

"The probable solution will be a combination of aural and visual devices, plus better dissemination of information to the pilot which, in itself, may be the toughest problem of all. I don't think that relying upon visual devices alone will solve the problem."

Dick Dinning: "I'd like to emphasize one point. The CAA is a logical agency to aid the television industry in selecting sites acceptable to the

aeronautical industry, and it is important for the CAA to have sufficient personnel and facilities to do this job.

"The problem of adequate notification of tower construction has been brought up. The Civil Aeronautics Act of 1938 requires anyone constructing an obstruction to notify the CAA of the intended construction. Also, I believe, the FCC forwards a postcard to the tower applicant when his construction permit is issued, and that postcard has to be mailed by the company doing the construction work, to the Coast and Geodetic Survey when the tower structure is completed. However, all this puts a burden on the CAA for keeping track of the progress of the tower construction. When the tower has been built to a height that affects aviation, the CAA should be aware of it and should issue adequate notification. This is a difficult job of bird-dogging which requires sufficient CAA personnel."

Jay W. Wright: "We're familiar with these notifications and, insofar as it is humanly possible, we have tried to comply with the directions we have received. It is conceivable that there are some stations that have not been as prompt as they should be in notifying the CAA. Perhaps there should be some double-checking.

"I'd be remiss if I didn't take this opportunity to express the pleasure that we have in our organization with way in which the various branches of the CAA have shown their willingness to help and actually have helped us in choosing these locations. They have been patient with our side of the problem and have successfully explained to us their side of the problem, with the result that we have found adequate locations for our towers in most instances, and with a minimum dislocation of the aeronautical interests."

J. Lederer: *"Gentlemen, this has been a most enlightening meeting and should do much to help develop a solution to the problem. Before closing the discussion, I would like to offer this summary.*

1. A procedure has been established by regulation to provide for approval of TV tower sites and notification of erection after 100-foot altitude has been reached.

2. But the location of tall TV towers in areas hazardous to flying and/or the erection of towers without notice to the aviation industry indicates that the procedure does not always work for the mutual interests of aviation and/or broadcasting.

3. The random location of TV towers and supporting cables may be even more serious for helicopter op-

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eration because they are required by economic reasons to fly low and are not confined to a definite pattern.

4. Where a multiplicity of broadcast stations co-exist, such as in the New York area, there is a general agreement that a desirable solution would be a common location or 'cluster' for all towers.

5. Research is needed to determine ways to improve the visibility of tall towers and their supporting cables.

6. Suggestions made for such markings (VFR) were:

a. Lighting with high-intensity lights.

b. The attachment of light-weight balls, aluminum or plastic, colored to contrast with background, such as are used in Europe. These balls are strung along the cables at intervals of about 100 feet.

c. Adding visual 'mass' by large objects such as balloons; grouping the towers with other TV towers or other high obstructions. (The mass idea was considered desirable, but there was some doubt about the use of balloons.)

d. Large markings on the ground around the periphery as outlined by guy wires. (There appeared to be agreement that this is a good idea if coupled with marking of towers.)

7. For IFR operation, radio squealers, bloopers or equivalent signals (aural signals) such as used in England in World War II to alert pilots of nearby barrage balloons was suggested. Several organizations are investigating this possibility.

8. The moderator indicated that we should not wait for a perfect solution to this problem. A solution that is 80% or 90% effective would help.

9. Steps should be taken to encourage every CAA region to do a better job of "bird-dogging" the erection of TV towers.

10. Improved dissemination of information regarding the location of towers and erection of new ones is very necessary, but for current type of helicopter operations a multitude of notices appears to be impractical, as might also be cockpit gadgets to warn of approach to an obstruction.

11. The erection of high towers not only is a hazard to the flying public but also involves important economic repercussions in air-transport operations.

12. The problem has been reduced by a cooperative spirit among those concerned; yet the problem continues to exist and may become more grave.

"Gentlemen, this brings our meeting to a close."

Mountain Wave

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of the mountain range and for several thousand feet above, with a steady strong flow up to the tropopause. The character of the wave varies with different wind profiles. A *very* strong increase of wind with height can eliminate the wave, leaving only stagnant air in the valley. Frequently, when a strong wave forms, the jet stream—or zone of strongest wind flow, moves southward to a position in the neighborhood of the range.

In the western United States where these waves have been most frequently observed, it has been noticed that the strongest waves develop when there is a cold front approaching the mountains from the northwest and/or a trough aloft approaching from the west. This produces a strong westerly flow over the mountain ranges which have a north-south orientation.

The most dangerous features of the wave are the turbulence in and below the rotor cloud and the downdrafts just to the lee of the mountain peaks, and to the lee of the rotor cloud. The downdrafts to the lee of the rotor, and the updrafts below it, can carry a plane into the rotor cloud while a pilot is attempting to pass above or below this cloud. The best procedure for one caught in the rotor cloud is to nose down to pick up speed and to attempt to reach the updraft area in advance of the rotor to regain altitude.

These dangers cannot be stressed too much. A pilot without specific experience in flying the wave should not attempt a flight through such conditions.

A combination of the winter temperature error and the wave error in the altimeter reading, together with the strong downdraft conditions near the peaks and the fact that they are hidden most of the time by the cap cloud, make it very likely that a plane at minimum clearance altitude would fly *into* the mountain peaks.

From calculations and instrument considerations, it has been shown that altimeter errors are associated with the wave conditions. Since the wave is for the most part a winter phenomenon, the temperature error in the altimeter reading contributes to an over-estimation of the flight altitude. The maximum total error possible has been computed to be about 1,000 feet. Altimeter errors as high as 2500 feet near the mountain peaks have been claimed by pilots although this seems an extreme figure. Data is not yet available to prove or disprove these figures.

The following rules of flight have been suggested for flights over mountain ranges when wave conditions exist. It would be good to keep these procedures in mind when clearing a plane for such a flight.

1. If possible, fly around the area when wave conditions exist. If this is not feasible, fly at a level which is at least 50% higher than the height of the mountain range.
2. Do not fly high-speed aircraft into the wave. Particularly, do not fly downwind. Structural damage may result.
3. Avoid the rotor cloud.
4. Avoid the foehnwall area with its strong downdrafts.
5. Avoid high lenticular clouds if the edges are very ragged and irregular, particularly if flying high-speed aircraft.
6. If necessary, updraft areas (especially the one in front of the rotor cloud) may be used as an aid in gaining the altitude necessary to pass through the downdraft area and cross the mountain range.
7. Do not place too much confidence in pressure altimeter readings near the mountain peaks.

Normal techniques can be employed in forecasting the upper winds when the stability and direction of flow are expected to be favorable for a wave condition. In the Sierras, the technique employed is to decrease the 10,000-foot wind forecast by one fourth and increase the 18,000-foot wind by one third to account for the local effect of the crest line (10,000 feet being below the level of the ridges, and 18,000 feet being above).

To apply forecast techniques to other ranges, especially when ranges have a different orientation. local studies should be made to determine the characteristics of the flow in the area concerned and thus learn the local forecast rules to be applied.

In the Sierras, it was found that a well-developed wave would form with a wind speed of 25 knots or more normal to the range line at mountain-top level. This is probably a good threshold value to apply in *any* mountain range. Certainly wind speeds of greater than 25 knots will create *some* disturbance to the lee of *any* mountain barrier. As previously stated, the mountain heights above surrounding terrain, the leeward slope of the mountains, and wind profile are all factors in determining the intensity of the wave.

One should look for an increase in the horizontal temperature gradient aloft north of the mountain range providing a thermal wind increase over a period of 12 to 18 hours before wave formation.

This study was conducted in the Sierras, but the same type of wave has been observed all over the world, and for years sailplane pilots have made us of these waves as an aid in soaring.

While the information contained in this report may not be the final work in preparing the forecaster to handle every forecasting problem connected with wave patterns in mountain ranges, it will provide a basic understanding of what the wave is and what is necessary in the way of atmospheric conditions for its formation.

To summarize the weather conditions under which a wave will form, the following requisites are considered to be necessary in the case of *any* mountain range.

1. Wind flow normal to the range and with a speed of 25 knots or more at mountain-top level.
2. A wind profile which shows an increase in wind speed with altitude near mountain-top level and a strong steady flow at higher levels extending to the tropopause.
3. An inversion or stable layer somewhere below 600 mb.

With a mountain range which extends north and south, the approaching cold front and/or north-south trough aloft should be considered as a probable igniting factor for the wave.

Off-Airways Operations

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IFR operations. The operational ranges shown may be expected under normal conditions only; they would not hold true in heavy thunderstorms, rain or snow static, etc.

The ranges in *Fig. 2* are, of course, approximate, and it is assumed that normal certificated radio-navigation equipment is aboard the aircraft. Under no circumstances should any flight be conducted on instruments where there exists long reaches of terrain over which no radio-navigational aids are provided. The total navigable distance may be lengthened if there are nearby radio stations enroute on which DF fixes may be obtained. A higher degree of navigational accuracy is required when off-airway IFR flight subsequently joins an airway, since airway traffic separation is premised on the assumption that the ETA will be made good within rather close tolerances.

Similar precautions should be taken in planning night VFR flights off-airways as for IFR flights. Unless suitable landmarks are available for pilotage navigation, radio aids should provide adequate signals to permit radio navigation over the entire segment to be flown. The table on IFR flights should apply. Pilotage navigation without the use of radio aids may be conducted provided the route lies over or near cities of such size that they may be readily identified and are of sufficient frequency to give speed and course checks at least once each half hour. The latter applies generally only over relatively flat terrain. It is not recommended for navigation in mountainous country unless the frequency of the cities enroute is considerably greater. Well-travelled highways may be followed with some discretion, as they may become pitfalls to the unwary.

There are other off-airway hazards to be considered, such as:

Terrain

Pilots should carefully check the terrain to be traversed. This is particularly true in the West where mountainous heights may well exceed the performance capabilities of the aircraft. Federal Airways generally follow terrain which is least hazardous.

Weather

High-altitude flight which may be necessary off-airways may require penetrations of weather phenomena at unsafe altitudes. Dangerous turbulence and icing may be found.

Emergency Landing

Airways which cover hazardous terrain generally have auxiliary landing fields at 100-mile intervals which may be readily used in the event of trouble. Off-airways, the places where emergency landings may be made are few and far between.

Enroute Altitudes

For IFR or night VFR, flight altitude should clear all obstructions within 25 miles on either side of the course to be flown by at least 1,000 feet in flat country and by 2,000 feet in mountainous country. In some special cases, particularly where navigational accuracy may be questionable, greater lateral tolerances are recommended. Here again, the off-airways flight offers a hazard not to be found on the civil airways. On the latter, the safe terrain clearance altitudes are carefully determined by the CAA and are published for use only after they have been flight checked. Sectional charts used for off-airway navigation may not contain the most accurate or recent data concerning natural or man-made obstructions (TV towers, for example).

In planning fuel requirements to destination and alternate airports for any flight which may be conducted either in part or entirely off-airways, pilots should provide more than the normal fuel reserve if the flight is to be conducted under IFR conditions. This is necessary due to the greater navigational inaccuracies which may be encountered as compared to airways operations. If the guide on radio coverage presented is followed, accuracy generally should be comparable to that provided on the airways. However, it is well to remember that the airway facilities are in constant use and are periodically checked; the CAA makes no representations as to the accuracy of signals by these same facilities over uncontrolled airspace.

In plotting off-airway courses, the pilot should make certain that his path of flight does not pass through any danger or prohibited areas. The very latest government publications containing this information should always be consulted. In regard to ADIZ penetration, it is suggested that flights so involved penetrate on the airways and remain within the airways when inside these zones. It is extremely difficult in most cases for a pilot to navigate within the prescribed tolerances in the ADIZ's without the use of radio navigation aids provided on Federal Airways. Penalties for failing to conform to these tolerances are severe.

It may be rightly assumed by anyone reading the foregoing that off-airways flights are not as desirable

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(Continued on Page 52)

Off Airways Operations

(Continued from Page 47)

as on-airways operations, especially IFR or night VFR. It is believed that the preponderance of safety advantages to be found on the Federal Airways is so great as to rule out the majority of off-airways flights proposed only as a time-saving measure. The mere fact that a circuitous routing, which may be necessary if the airways are followed, may require an intermediate landing and refueling is not sufficient reason for risking the hazards of off-airways operations.

The points can be summarized:

1. Adherence to quadrantal altitudes as required in CAR 60.44 (b) is the only means of separation of IFR off-airways traffic. This is no guarantee against mid-air collision because:
   a. No separation is available between aircraft on converging courses in the same quadrant.
   b. Pilots disregard or forget quadrantal altitude.
   c. Other pilots adhere to last-assigned ATC cruising when off-airways.
2. Possible methods of navigation, their accuracy, and limitations should be noted in planning of off-airways flights. Greater than normal fuel reserves should be included in some instances, especially under IFR when radio navigational coverage outlined above is marginal.
3. For night VFR navigation, unless the route is well marked with easily recognizable cities and towns at frequent intervals, radio-navigation coverage should be the same as for IFR.
4. Other considerations are.
   a. Altitude of flight should clear all obstacles 25 miles either side of course to be flown by 1,000 feet in flat terrain and 2,000 feet in mountainous terrain.
   b. Weather reporting and forecasting is generally not as accurate off-airways as on. Numerous reporting stations as well as frequent pilot reports make airways weather service appreciably better than off-airways.
   c. Search and rescue facilities as well as emergency landing fields are more adequate on the airways.
5. The pilot preparing for off-airways flight should make certain that his course does not pass through active danger areas. Consult ADIZ charts.
6. If, after considering all of the above, the flight off-airways appears questionable, *fly airways* instead, even though it means an extra refueling stop.

FIG. 2

TYPE OF RADIO FACILITY

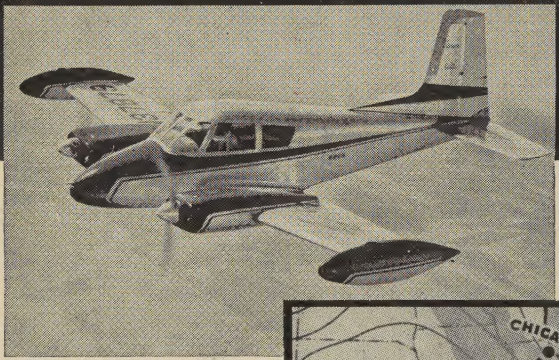
Departure Point or Last Airway Fix	Destination or Airway	Total Effective Distance (Statute Miles)
1. LF Range (Adcock) (RA)	LF Range (Adcock) (RA)	200 Miles
2. LF Range (Adcock) (RA)	LF Range (Loop) (RL) or vice versa	150 Miles
3. LF Range (Loop) (RL)	LF Range (Loop) (RL)	120 Miles
4. H Facility	H Facility	100 Miles
5. Low-Powered Loop Range (MRL or ML)	Low-Powered Loop Range (MRL or ML)	60/80 Miles
6. MH Facility	MH Facility	60 Miles
7. MH	Low-Powered Loop Range (ML) or vice versa	50 Miles
8. VOR	LF Range	Effective range depends on flight altitude
9. VOR	VOR	Effective range depends on flight altitude

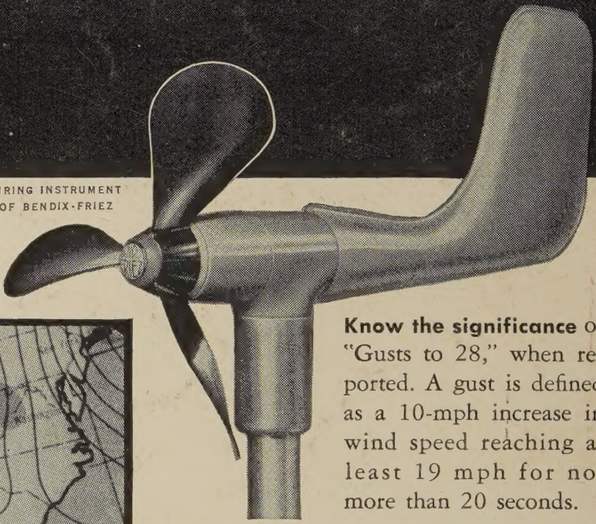
NOTE: All possible power combinations have not been included.

FLY SAFELY

These weather items prepared in consultation with the United States Weather Bureau

In warm, fair weather surface winds may increase beyond safe limits in mid-afternoon. A safe wind at take-off may increase dangerously by the time you land. Watch for this.

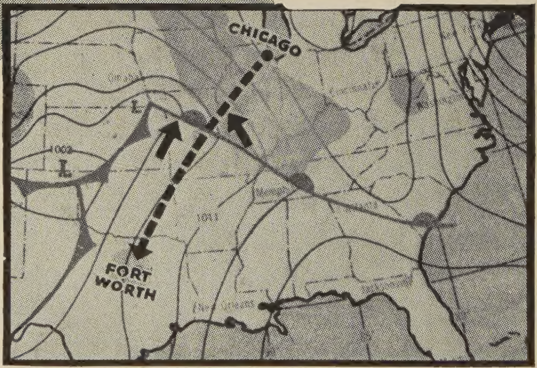




WIND MEASURING INSTRUMENT COURTESY OF BENDIX-FRIEZ

Know the significance of "Gusts to 28," when reported. A gust is defined as a 10-mph increase in wind speed reaching at least 19 mph for not more than 20 seconds.

Slight turbulence in clear air often signals a change in wind direction or velocity—check your drift and ground speed when you run through a patch of choppy air.



Expect a change in wind whenever you fly through an area of changing weather. Wind shifts are frequently associated with edges of rain or cloud areas.

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